

host radar tracking simulation and performance analysis technical note

Host Radar Tracking Simulation and Performance Analysis

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16. Abstract A recording of approximately four hours of air traffic data was collected in Washington DC Air Route Traffic Control Center on March 17, 2005. The Automation Metrics Test Working Group supplied this data to the Integration & Interoperability Facility that ran a simulation using the FAA's Graphical Simulation Generation Tool (GSGT) simulator. The simulation produced the Host Computer System (HCS) tracks reports and GSGT positions. The GSGT positions were considered the actual path the aircraft flew in which the HCS track positions were measured against. A series of data processing steps were run comparing the GSGT positions to the HCS track reports. Four error metrics were applied including horizontal error, its orthogonal components cross and along track error, and altitude error. For this study, the mean horizontal error was 0.85 nautical miles. The cross track error distribution is symmetrical about zero nautical miles and a root mean square value of 0.14 nautical miles. However, the along track error distribution is strongly skewed in the negative direction with an average error of -0.83 nautical miles. This represents an uncompensated time error.			
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Executive Summary

The Federal Aviation Administration's (FAA's) En Route Automation Modernization (ERAM) Test Group (ACB-550) formed the Automation Metrics Test Working Group (AMTWG) in 2004. The team's charter is to support the developmental and operational testing of ERAM by developing a set of metrics that quantify the effectiveness of key system functions in ERAM. The targeted system functions are Surveillance Data Processing (SDP), Flight Data Processing (FDP), Conflict Probe Tool (CPT), and the Display System (DS) modules. The metrics are designed to measure the performance of ERAM. They also are designed to measure the performance of the legacy En Route automation systems in operation today. When appropriate, they will allow comparison of similar functionality in ERAM to legacy systems (e.g. Host Computer System).

The project is divided into key phases: first a metrics identification process was performed. A list of approximately one hundred metrics was generated by the AMTWG and mapped to the Air Traffic services and capabilities found in the Blueprint for the National Airspace System Modernization 2002 Update. This took place most of fiscal year 2004 and initial metrics results were published in June 2004 in the document titled, "ERAM Automation Metrics Progress Report of the Automation Metrics Test Working Group". Next, an implementation-planning phase was performed. In this step, the identified metrics were prioritized for more detailed refinement during 2005. The plan "ERAM Automation Metrics and Preliminary Test Implementation Plan," documents the implementation-planning phase. It lists these metrics, gives the rationale for selecting them, and provides a high level description on how the highest priority metrics will be measured.

The final project phase is the data collection and analysis phase. In this step, AMTWG will further refine and apply these metrics on the current legacy systems in a series of Metric Reports. AMTWG is planning the delivery of four Metric Reports for the 2005 calendar year covering several of the ERAM subsystems, two of which have already been completed. The tracking of aircraft by the ERAM surveillance radars is a basic ERAM function within the SDP subsystem. This study implements a simulation capability and measures the accuracy of the existing radar tracking function in the Host Computer System (HCS). The companion report is titled: "Comparison of Host Radar Tracks to Aircraft Positions from the Global Positioning Satellite System," estimates the performance of the existing HCS tracking function as well. The main difference is the prior study used global positioning satellite (GPS) positions as ground truth, and this study utilized the FAA's Graphical Simulation Generation Tool (GSGT). The GPS based study provides an accurate measure of HCS tracker performance but is very costly to repeat and thus can only be indirectly used to evaluate ERAM. The current simulator based study could be modified for input into ERAM providing a direct comparison. Therefore, both approaches complement each other. The previous GPS based study provides the absolute accuracy results and the current study is available for potential use in ERAM.

A recording of approximately four hours of air traffic data was collected in Washington DC Air Route Traffic Control Center on March 17, 2005. AMTWG supplied this data to the Integration & Interoperability Facility (IIF), who ran an empirical simulation using the FAA's GSGT application with an induced radar noise deviation of +/- 2 Azimuth Change Pulses. The simulation produced the HCS tracks reports and GSGT positions. The GSGT positions were considered the actual path the aircraft flew in which the HCS track positions were measured against. The data reduction produced 1342 flight segments and resulted in 298,336

measurements calculated. For each of these measurements four metrics were calculated and stored in a relational database.

The accuracy is measured in terms of four performance metrics, including: horizontal error that is the unsigned distance between the time coincident radar track and GSGT simulated position, along track error that is the longitudinal orthogonal component (ahead and behind) of the horizontal error, cross track error that is the lateral orthogonal component (side-to-side) of the horizontal error, and altitude error defined from taking the difference between the HCS tracked altitude and the altitude generated by GSGT.

For this study, the mean horizontal error was 0.85 nautical miles. The cross track error distribution is symmetrical about zero nautical miles and a root mean square value of 0.14 nautical miles. However, the along track error distribution is strongly skewed in the negative direction with an average error of -0.83 nautical miles. The HCS tracker's position is consistently lagging in time. The errors reported in this study are comparable to the prior companion study, yet the current simulation generates slightly larger errors due to approximations in the simulation process. The symmetric and lagging error distributions are illustrated in Figure ES-1. Practically the same histogram patterns were produced in the companion study.

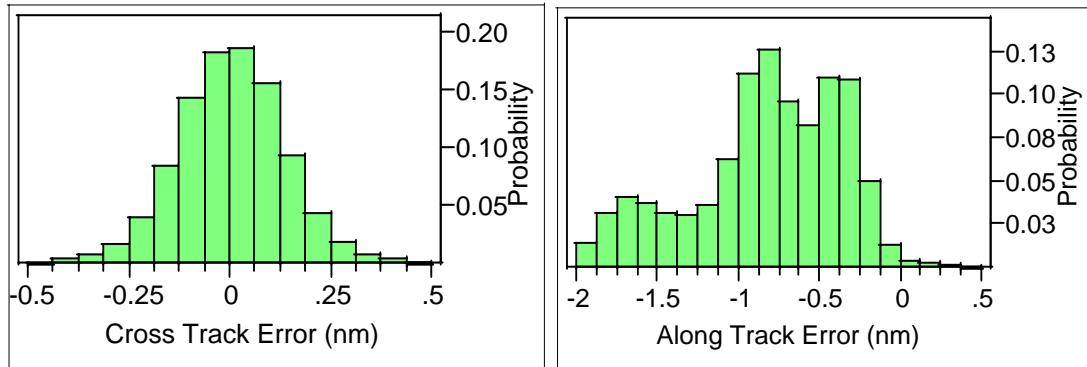


Figure ES-1: Histograms of Tracker Errors

Inferential tests were performed that attempted to determine the impact of turning, vertically transitioning, and altitude level on the HCS tracker's performance. The results provided evidence of modest impacts on the along track error and no impact on the cross track error but inconclusive results on the altitude error. More importantly, several key lessons were learned for future application to ERAM, such as developing better methods to determine these events and improved statistical methods of pairing and properly sizing the sample for the test.

Finally, the study ended with detailed reviews of selected flights. For example, the first flight segment selected represents an arrival flight of a large twin engine jet. It captures a series of interim altitudes issued by the controller during its descent to handoff to terminal control. A 360 degree turn occurs during the aircraft's descent resulting in a maximum horizontal error of 1.4 nautical miles. In both the descent and turn, the HCS tracker seems to over smooth the positions creating error as it does. It is assumed that the advanced tracker in ERAM could better handle the step climbs and large turn, making this flight example an excellent test case for ERAM.

This analysis helps address ERAM COI 1.0 as discussed above by providing a dataset and analysis methodology to later apply to the ERAM system. It also advances the ERAM metrics development documented in AMTWG Implementation Plan.

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1 Introduction

1.1 Purpose

The Federal Aviation Administration (FAA) has begun development of a new Air Traffic Control (ATC) system to replace the existing Host Computer System (HCS) in the en route domain. The Host system is used by all twenty en route ATC Centers in the continental United States. The new system, called ERAM (for En Route Automation Modernization), is being developed by the Lockheed Martin Corporation. As documented in the FAA's *Test Evaluation Master Plan*, the ERAM Test Program is required to ensure key operational issues are verified (WJHTC/ACB-500 2003). These issues are organized as Critical Operational Issues. The first Critical Operational Issue (COI 1.0) requires that ERAM supports ATC operations with at least the same effectiveness as the current system. As an example, one of ERAM's subsystems, the Surveillance Data Processing function, is therefore required to perform as well as the existing Host radar tracking function. To determine this, a baseline performance of the Host is required to provide performance standards to later compare to ERAM. A previous study was completed and documented in the report titled, "Comparison of Host Radar Tracks to Aircraft Positions from the Global Positioning Satellite System," (Ryan and Paglione, 2005). The current study documented in this report complements the previous study in that it uses simulation to evaluate the legacy Host tracker performance. However, the main benefit is it produces a capability and data set that could be input into the ERAM future implementation of these functions.

This technical note documents the results of comparing the HCS aircraft tracks with tracks obtained from the running a simulation in the William J. Hughes Technical Center (WJHTC) Integration & Interoperability Facility (IIF). This study is one of several proposed and planned by the Automation Metrics Test Working Group (AMTWG) in the "ERAM Automation Metrics and Preliminary Test Implementation Plan," published in June 2005 (WJHTC/ACB-330 2005).

1.2 Background

The FAA's ERAM Test Group (ACB-550) formed the Automation Metrics Test Working Group (AMTWG) in 2004. The team's charter is to support the developmental and operational testing of ERAM by developing a set of metrics that quantify the effectiveness of key system functions in ERAM. The targeted system functions are Surveillance Data Processing (SDP), Flight Data Processing (FDP), Conflict Probe Tool (CPT), and the Display System (DS) modules. The metrics are designed to measure the performance of ERAM. They also are designed to measure the performance of the legacy En Route automation systems in operation today. When appropriate, they will allow comparison of similar functionality in ERAM to legacy systems (e.g. HCS).

The project is divided into key phases: first a metrics identification process was performed. A list of approximately one hundred metrics was generated by the AMTWG and mapped to the Air Traffic services and capabilities found in the Blueprint for the National Airspace System Modernization 2002 Update (FAA 2002). This took place most of fiscal year 2004 and initial metrics results were published in June 2004 in the document, "ERAM Automation Metrics Progress Report of the Automation Metrics Test Working Group" (WJHTC/ACB-550 2004). Next, an implementation-planning phase was performed. In this step, the identified metrics were prioritized for more detailed refinement during 2005. The plan "ERAM Automation Metrics and Preliminary Test Implementation Plan," documents the implementation-planning phase. It lists these metrics, gives the rationale for selecting them, and provides a high level description on how

the highest priority metrics will be measured. The Implementation Plan provides the metric's traceability to the basic controller decisions, ERAM Critical Operational Issues (COIs), and the development contractor's technical performance measurements (TPMs). The categories of high priority metrics are: (1) SDP radar tracking, (2) SDP tactical alert processing, (3) FDP flight plan route expansion, (4) FDP aircraft trajectory generation, (5) CPT strategic aircraft-to-aircraft conflict prediction, (6) CPT aircraft-to-airspace conflict prediction, (7) additional system level metrics, and (8) DS human factor and performance metrics.

The final project phase is the data collection and analysis phase. In this step, AMTWG will document the further refinement and application of these metrics on the current legacy systems in a series of Metric Reports. AMTWG is planning the delivery of four Metric Reports for fiscal year 2005 with one covering each of the ERAM modules discussed above, SDP, FDP, CPT, and DS respectively. These reports will be published in multiple drops to provide the ERAM Test Team on-time information. The drops will document the various approaches used to implement the metrics. This technical note documents the second drop on SDP's surveillance tracking algorithms. It documents the radar tracking positional accuracy of the Host as compared to the FAA's Graphical Simulation Generation Tool (GSGT) simulated aircraft positions. GSGT is an FAA simulator residing in the IIF Laboratory. The results in this study are comparable to previous studies by AMTWG recently in early August (Ryan and Paglione, 2005) and by Trios Corporation in November 2003 (Trios Inc., 2003).

1.2.1 FAA En Route Host Tracker History

The FAA's replacement of the en route ATC automation system, called ERAM, is being developed by the Lockheed Martin Corporation. The current en route ATC system is referred to as the Host Computer System (HCS), which is an IBM S390. ERAM will replace the HCS (or Host) with a new network based computer system consisting of a modern day set of distributed IBM processors. The FAA HCS radar data tracker has been used by the FAA at the en route Air Route Traffic Control Centers (ARTCC) since the early 1970s. ERAM will replace the original National Airspace System (NAS) HCS tracker with a new modern Kalman Filter based tracker. It will be built upon the similar tracker already deployed in the FAA's current Standard Terminal Automation Replacement System (STARS).

1.2.1.1 NAS IBM 9020 System

The early en route tracker was an Alpha Beta tracker written in the IBM BAL (Basic Assembler Language) and executed on the IBM 9020 A and D computer system as shown in Figure 1. Those computer systems were a multiprocessor complex composed of IBM 360 Model 50 and 65 Central Processing Units (the largest of the IBM product line in their day). The tracking programs were allowed to run all of the time and utilize all of the CPU power available in that system to process the FAA ATC track load.



Figure 1: FAA NAS IBM 9020 A/D Air Traffic Control System

1.2.1.2 NAS HOST System

About 1983 the original NAS 9020 computer programs for the en route NAS software system were re-hosted on IBM 3083 computer running Virtual Machine (VM) in Figure 2. This program became known as the Host (or HCS) and the name remains to this day. The IBM 3083 Processors were 16 times more powerful in computation performance and many times larger in memory capacity than the predecessor IBM 9020 systems. The en route tracker was re-hosted in the BAL language on the new IBM 3083 processors.



Figure 2: FAA NAS IBM 3083 Air Traffic Control System (Host)

1.2.1.3 HOST Computer System Replacement (HOCSR)

In the 90's the IBM 3083 computer complex underwent a technical refresh to replace the old IBM 3083 computers with the HOCSR, Host and Oceanic Computer System Re-host. The replacement consisted of IBM System 390 computers with OS/390 operating system, as shown in Figure 3. The BAL version of the en route tracker was ported to this new machine.



Figure 3: FAA NAS IBM System 390 ATC System (HOCSR)

1.2.1.4 Modernization - ERAM

Illustrated in Figure 4, in the 2005 to 2008 time frame, the en route tracker and conflict alert algorithms are to receive a major upgrade in the ERAM program. The 1970's en route tracker will be replaced with the new STARS like tracker utilizing a state-of-the-art Kalman Filter tracker. The conflict alert algorithms are undergoing a major upgrade to work in conjunction with the new tracker. The new computer system will be a distributed network based computer system with IBM 72 bit processors. The subject of this study is development of a traffic scenario for testing the HCS radar tracker and establishing a benchmark of performance for the current radar tracker in the HCS in use today.



@server p5 550 rack system with I/O drawer.

Figure 4: FAA ERAM IBM Processors

1.3 Scope

Approximately 1500 aircraft flight segments were recorded from the Washington DC Leesburg ARTCC (ZDC). Five hours of traffic data collected from ZDC on March 17, 2005 was processed and input into the FAA's Graphical Simulation Generation Tool (GSGT) in the IIF Laboratory. Using this data, the simulator generated radar positions with +/- 2 Azimuth Change Pulses (ACPs) of radar noise and supplied surveillance radar to the IIF HCS adapted for ZDC. For this study, the GSGT generated positions are considered to be the ground truth aircraft position. The error measurements are the difference between the GSGT simulated aircraft positions and the output of the HCS tracker. The approach establishes a dataset and methodology to evaluate the ERAM radar tracker's performance in the future.

The evaluation includes metrics for both the horizontal and altitude dimensions. Leveraging on past work from the User Request Evaluation Tool (URET), four distance metrics were applied in this study, which were documented in (Paglione, et al., 1999) and (Cale, et al. 2001). These included (1) horizontal error, (2) longitudinal or along track error, and (3) lateral or cross track error, and (4) altitude error. Descriptive statistics have been calculated for these metrics, such as sample mean and standard deviation. Inferential statistical tests have been performed to determine whether or not the tracker accuracy is influenced by factors such as the current aircraft altitude or whether the aircraft was turning or transitioning vertically.

1.4 Document Organization

This technical note is organized into the following primary sections. Sections 2 and 3 describe the data collection and data reduction processes, Section 4 defines the analysis with statistical measures and their application. Conclusions are provided in Section 5. Additional details of the study are given in the Appendices.

2 Data Collection

To establish a realistic baseline of performance, the FAA desired to use actual recorded radar and system data to evaluate the new ERAM tracker against the current legacy HCS tracker. The live en route radar data was recorded on the HCS at ZDC using the Host System Analysis Recording (SAR) and Online Radar Recording (ORR) capabilities. As the aircraft travel through an ARTCC, they fly through the airspace from sector to sector. ATC ownership and control of the aircraft is based upon these sectors and the controllers assigned to the sectors. Control messages modifying the flight plan, assigned altitude, assigned beacon code, handoffs from sector to sector and NAS to NAS communications are processed by the HCS as the aircraft traverses the airspace. Controller messages must be entered to enable the NAS to properly process the flights in conjunction with the radar data inputs. These messages, such as filing flight plans, amending flight plans, assigning altitudes, performing and accepting handoffs, initiating and dropping tracks, and removing flight strips are captured on the SAR recordings.

The recorded radar data was then processed at the WJHTC IIF to extract radar data, flight data, keyboard inputs, and interfacility messages using the FAA GSGT application. The GSGT has the capability of creating air traffic simulations that can be replayed using the Host Direct Simulation function or the FAA Simulation Driver Replacement (SDRR). In this case, the GSGT was used to create an SDRR simulation containing the radar, interfacility messages, and a Host Direct Sim tape containing the keyboard and other system messages. The SDRR was used to send the data over serial lines to the En Route Communication Gateway (ECG) in the same manner that data comes over telephone lines and modems into the operation ARTCCs. The radar and ATC messages were then processed by the HCS. Data from these simulation runs was captured using

Host SAR and the Common Message Set (CMS) data stream. Finally, the GSGT generated positions and CMS data were evaluated using the FAA WJHTC Simulation and Analysis Group's data reduction and analysis tools.

2.1 ARTCC Radar Data Collection

The HCS at each ARTCC routinely perform data recording for off line data reduction and analysis of the computer system's performance. The data recording is recorded onto SAR computer tapes. Subsequently, the SAR tapes are analyzed and reduced off line using standard computer programs developed in the 1960s as part of the original NAS software development for the 9020 computer systems. The SAR tape process still exists today at the operational ARTCCs. The SAR tapes are used to find downed aircraft, perform traffic counts and evaluate any air traffic incidents. The HCS SAR tapes were retrieved from ZDC, located at Leesburg, Virginia on March 17, 2005 and forwarded to the WJHTC IIF for conversion to a radar test simulation.

2.2 Input HCS SAR into GSGT

The radar track data was sampled at 1-minute intervals and processed by the FAA's GSGT at the IIF. The radar data was smoothed by the GSGT between each 1-minute interval. The HCS's non-radar messages from various sources (e.g. NADIN, FDIO, HOST KVDT, DSR keyboard messages) were also extracted from the SAR tapes by the GSGT. Interfacility messages for ZDC's six ARTCC neighbors and 15 Terminal Area facilities were captured from the SAR tapes.

2.3 GSGT and SDRR Simulation Scenario

The FAA has developed the GSGT application that creates scenarios, which can be played as a legacy HCS simulation or drive the SDRR. SDRR simulates radar, interfacility and Display System Replacement (DSR) keystroke commands. For this study, the GSGT was used to generate the radar data files for the SDRR equipment at the IIF. The GSGT also created SDRR files of interfacility messages and a Host Simulation tape for keyboard and other messages. The resultant scenario runs approximately over 4 hours and provides 1500 targets. There were three variations of the scenario. The base scenario has no radar noise. The second variation has +/- 1 Azimuth Change Pulse (ACP) of noise deviation (1 standard deviation of 0.09 degrees containing 68% of the data). The third variation has +/- 2 ACP of noise deviation (1 standard deviation of .18 degrees containing 95% of the data). Due to time and resource constraints, this study used the +/- 2 ACP of noise deviation run only. It represents noises levels expected in the field.

The Scenario is played into HCS for approximately 4 hours and the traditional SAR data tapes from NAS are recorded along with the CMS message set normally sent to Host Air Traffic Management (ATM) Data Distribution System (HADDS) interfaces. For this study, IIF created a special data recording client to act as the HADDS interface and record the CMS messages directly to compressed files. The HADDS files are formatted in the Extended Binary Coded Decimal Interchange Code (EBCDIC) character set defined in (FAA, 2001) with message headers both in EBCDIC and binary.

3 Data Reduction

A number of computer processing steps were necessary to prepare the data for the comparison. Most of the software tools were developed for previous studies to examine the trajectory accuracy of decision support tools (Paglione, et al., 1999) and adapted here for this study as described in more detail in (Ryan and Paglione, 2005). The following subsections will summarize the basic processing steps.

3.1 Radar Data Reduction

As stated above, analysis tools to compare the HCS tracked radar data to the GSGT Simulation data were available from previous work comparing radar data to trajectories (predicted flight paths). These tools require the data to be in specific formats. The radar data was run through two scenario parsing programs. These programs convert the CMS messages from the binary/EBCDIC HADDS files as described previously in Section 2.3 to CMS ASCII format and then loads them into a set of Oracle relational database tables. The scenario format and resulting tables now contain human readable ASCII messages, referred to as CMS ASCII, which are defined in reference (Paglione and Oaks, 2004).

Host track data may contain gross errors due to lags in the recording process or other anomalous reasons. Thus, AMTWG runs the track data through a post-processing tool that checks for reasonableness. This is documented in detail in reference (Ryan and Paglione, 2004). Finally, the track reports are interpolated and synchronized to 10-second intervals timed to the hour of the day. This step is in preparation for later comparison to its companion GSGT data.

The resulting radar scenario's HCS tracked positions are compared to the ground truth positions captured from GSGT representing radar target positions as input to the HCS tracker. The difference represents the error in the tracking algorithm. This comparison is discussed further in Section 3.3 and resulting analysis is presented in Section 4. The overall process for data collection and data reduction is illustrated in Figure 5.

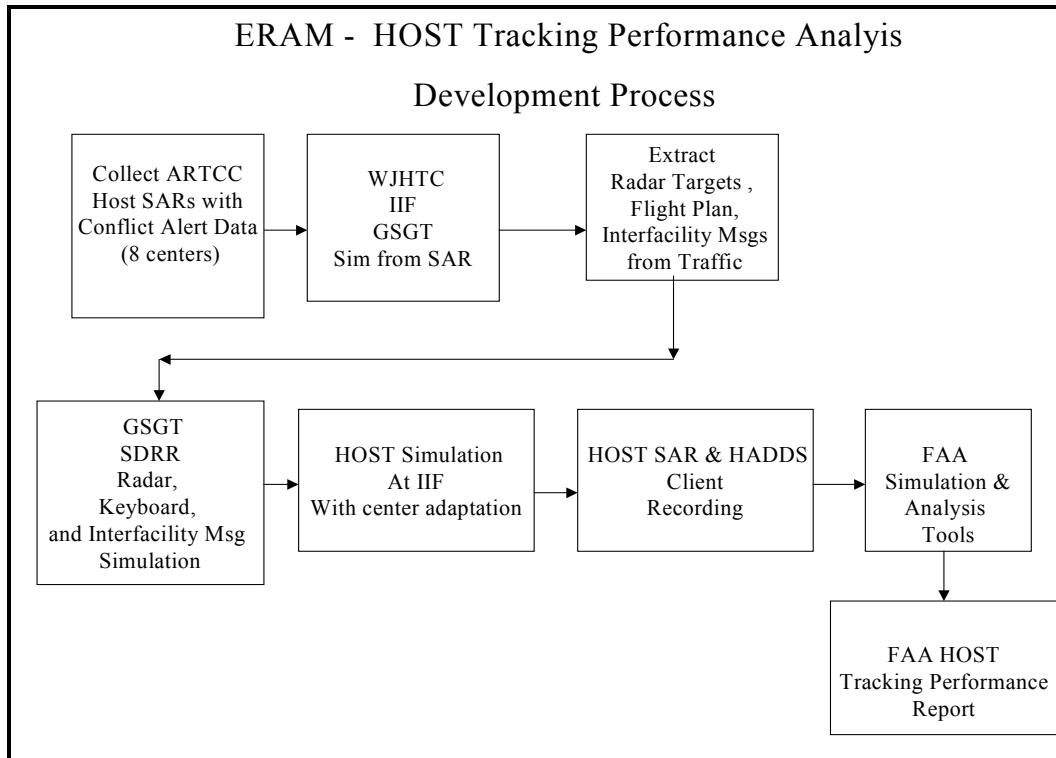


Figure 5: ERAM-HCS Tracking Performance Analysis Development Process

The entire traffic recording provided by the IIF in the HADDS format is transferred on a UNIX based workstation to where a series of UNIX shell, Oracle PL/SQL, GNU C/C++, and Java programs perform the various processes on the data, which were all developed by ACB-330. For

example, the radar data is reduced to two basic database tables: one with a record per flight segment and another listing all the HCS radar track positions, synchronized to 10-second intervals on the hour of the day. Also the track reports are converted from a latitude and longitude coordinate frame to the HCS horizontally flat stereographic coordinate frame.

3.2 GSGT Data Reduction

The GSGT data is provided by the IIF as a relatively large ASCII file. The file is comma and space delimited with position reports time stamped to one second intervals. Each flight simulated by GSGT has a series of position reports representing the simulated path of the aircraft. These flights are identified by the aircraft's call sign or aircraft identification string. ACB-330 developed a special Java program that extracts the aircraft positions from the file, samples the positions to 10 second intervals (matching the time interval used for processing the HCS track data), determines the associated HCS computer id, and filtering for only the position reports overlapping HCS track data by time. This program was run on the GSGT output file, processing 4,523,824 records and producing a final 1351 aircraft trajectory set. To utilize ACB-330's legacy tools developed to measure URET predicted trajectories, the special parsing program outputs the GSGT position reports into a trajectory file compatible with the legacy tools. This allows easy comparison against the HCS track data.

3.3 GSGT and Radar Comparison

After the collection and preprocessing of the radar and GSGT data, the two input sources are ready for processing using the existing track accuracy computer software tools. The radar track data, which are now coordinate-converted, checked for reasonableness, interpolated, and time synchronized to 10 second intervals, reside in a set of relational database tables. The GSGT positions, which are now parsed, coordinate-converted, and formatted into trajectory files sampled at 10 second intervals, are awaiting comparison in flat files.

3.3.1 Application of Interpolation for Time Coincidence

To calculate the time coincident spatial metrics defined in the subsequent Section 3.3.2, both the radar track data and GSGT positions must not only be in the same coordinate frame, but synchronized to the same time positions as well. The radar track data was already time synchronized to 10 second intervals on the hour. However, the GSGT trajectory positions were sampled at 10 second intervals but not synchronized to the hour. The software tool responsible for the comparison processing first linearly interpolates the GSGT positions to synchronize them to same 10 second intervals as the radar. Next, each aircraft's particular flight segment within the Center and coincident GSGT positions are matched by time and sent for processing the spatial metrics.

Note, the GSGT positions as originally supplied at 1 second time intervals, technically speaking, should not require any interpolation. However, due to compatibility issues with legacy software tools, it was necessary to sample at 10 second intervals and then later use interpolation to time synchronize to the track data. AMTWG determined that the impact of these steps to be negligible.

3.3.2 Spatial Metrics

Matched and synchronized in the previous step, a radar track position of an aircraft is compared to the time coincident GSGT position of the aircraft. Four metrics have been calculated for each pair of reports: (1) horizontal error, (2) along track or longitudinal error, (3) cross track or lateral error, and (4) altitude error. The details of the computation have been given in references (Paglione, et al., 1999) and (Ryan and Paglione, 2004) and partially repeated in Appendix 8.1. In

summary, horizontal error is the unsigned distance between the time coincident radar track and GSGT position. Along and cross track errors are the signed orthogonal components of the horizontal error. Along track is the longitudinal component. A positive value indicates the track is ahead of the GSGT position and negative is behind the time coincident GPS report. The cross track error is the lateral or side-to-side error component of the horizontal error. A positive cross track error indicates the track is to the right of the GSGT position and negative is to the left. The altitude error is the HCS altitude subtracted by the GSGT altitude.

4 Data Analysis

For the traffic sample previously described in Section 2, each HCS track report was matched with a time coincident GSGT radar position. For each of these matched positions, a set of four error measurements were calculated as defined in Section 3.3.2. This resulted in a total of 298,336 measurements for the 1342 sample of flight segments. The Data Analysis Section presents the results of calculating the four error metrics on this substantial traffic sample.

A small number of outliers have been excluded from this data. The outliers do not represent the basic accuracy of the Host radar tracking capabilities and represent artifacts produced from the data collection process. Flight segments that have a maximum error of greater than 4 nautical miles were categorized as outliers. Nine of the original 1351 flight segments have been excluded in this way (1351-9=1342), representing less than 1% of the measurements.

There are three subsections that follow: Section 4.1 includes the descriptive statistics that summarize the entire set of flight segments or categories of flight segments, next Section 4.2 presents statistical analyses that answer specific questions (for example what are the errors during level flight versus vertical transition, is the tracker performing the same during turns or at different altitude bands), and Section 4.3 presents three specific flights in detail to illustrate how the errors were calculated and what they represent.

For both the descriptive and inferential statistical analyses that follow, the precision of the data collected is an important consideration. For example, if the average error for a particular metric was smaller than the precision of the input data supplied for the study, it would for all practical purposes be considered insignificant. For the horizontal errors described in Section 3.3.2, the HCS track reports and GSGT positions are provided in degrees, minutes and seconds of latitude and longitude. The smallest unit horizontally is about 1/60 of a nautical mile or 0.02 nautical miles. Therefore, any horizontal result in the data analysis below 0.02 nautical miles can be considered insignificant or zero. For the vertical errors, all the altitude positions are supplied in units of 100 feet. Therefore, any vertical result below 100 feet can be considered insignificant as well. These thresholds represent the accuracy limits of the source data.

4.1 Descriptive Statistics

For this study, the descriptive statistics summarize and quantify the accuracy data collected for the horizontal, along and cross track, and altitude error metrics. The statistics typically used in this study are the sample mean and the root mean square taken from the sample of flight segments. The statistics are illustrated by graphical methods such as histograms in the subsequent sub-sections.

4.1.1 Overall Error Rates

The overall error rates for all flight segments and all measurements are listed in the following Table 1. For some statistics, such as the sample mean, the signed error values tend to cancel out.

Therefore, Table 1 provides both the signed and unsigned values for cross and along track and the altitude statistics.

The average signed cross track error is very small practically zero while the average unsigned (magnitude) cross track error is larger at about 650 feet. However, the signed and unsigned averages for the along track error are similar in magnitude, since along track errors are consistently negative. A large along track error represents a time error. Therefore, this data indicates that the HCS track report time stamping has an uncompensated error. At a speed of 420 knots, an error distance of 0.83 nautical miles corresponds to time error of about 7 seconds. The average altitude errors are very small exceeding the limit of detection (i.e. 100 feet). Hence the results for the mean altitude error are presented in Table 1 for illustrative purposes only.

The Root Mean Square (RMS) is the square root of the sample mean of squared errors. It is proportional to the sample mean of the unsigned metrics but tends to weight more heavily the upper and lower tails of the distribution. In Table 1, the RMS statistic for horizontal error was about a tenth of a nautical mile higher than the sample mean with similar results for the cross track error and along track error metrics. Since RMS squares the error measurements, it is the same for signed and unsigned errors. The RMS of the altitude error is significantly larger than the mean altitude error, and at 190 feet it is sufficiently above the accuracy limit of the source data (i.e. greater than 100 feet).

Table 1: Overall Error Rates

		Horizontal Error (nm)		Cross Track Error (nm)		Along Track Error (nm)		Altitude Error (feet)	
Type	Sample Size	Mean	RMS	Mean	RMS	Mean	RMS	Mean	RMS
Signed	298336	0.85	0.97	0.00	0.14	-0.83	0.96	20	190
Unsigned				0.11		0.83		60	

4.1.2 Overall Horizontal Error Distribution

The horizontal error distribution as presented in Figure 6 is skewed with two peaks, a sample mean of 0.85 nm and a median of approximately 0.79 nm. It appears that the sample data has a peak around 0.4 nm and another peak around 0.8 nm. Horizontal error is an unsigned metric by definition, so the skew is a result of the combination of its two orthogonal components along and cross track errors. The standard deviation of the horizontal error is 0.46 nautical miles. The 75th and 25th quartiles are 1.08 and 0.47, respectively.

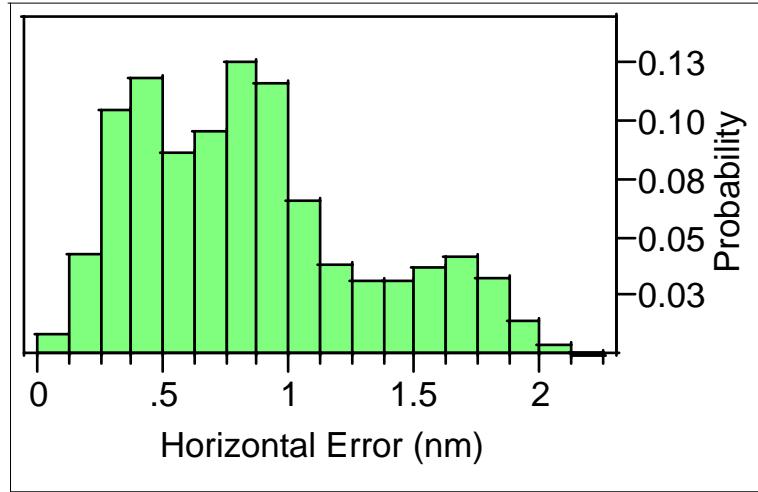


Figure 6: Overall Horizontal Error Distribution

4.1.3 Overall Cross Track Error

The cross track error is a signed metric that is symmetric around a population mean of zero. The sample mean is for all practical purposes zero at 0.00 nautical miles (0.002 resulted and is below the accuracy of the data source) and sample standard deviation of 0.16 nautical miles. The sample median is also 0.00 nautical miles and the 75th and 25th quantiles are 0.09 and -0.08, respectively. As presented in Figure 7, these results indicate a very symmetric distribution around zero nautical miles error.

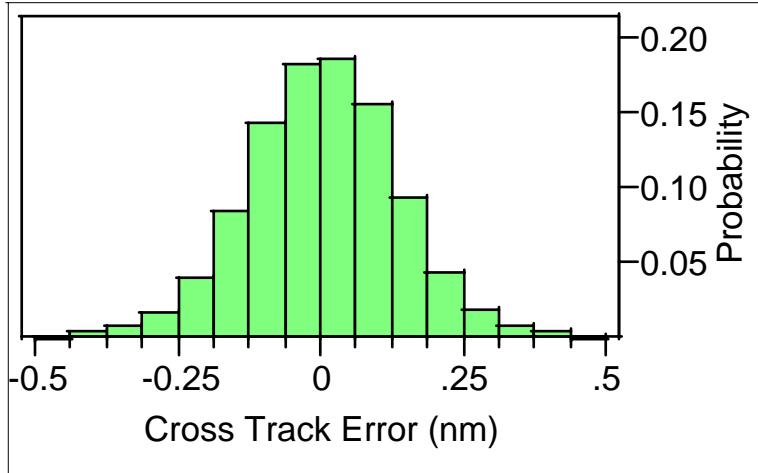


Figure 7: Overall Cross Track Error

4.1.4 Overall Along Track Error

The overall along track error is another signed metric like the previous cross track error, but unlike the very symmetric cross track error the along track distribution is significantly negatively

skewed, as evident in Figure 8. It has a sample mean -0.83 nautical miles and median of -0.78 nautical miles. The standard deviation is 0.47 nautical miles and the 75th and 25th quantiles are -0.45 and -1.07 nautical miles, respectively. Thus, the along track error not only provides the magnitude of the error but illustrates the inherent lag in the HCS tracker algorithm's smoothing of the aircraft position.

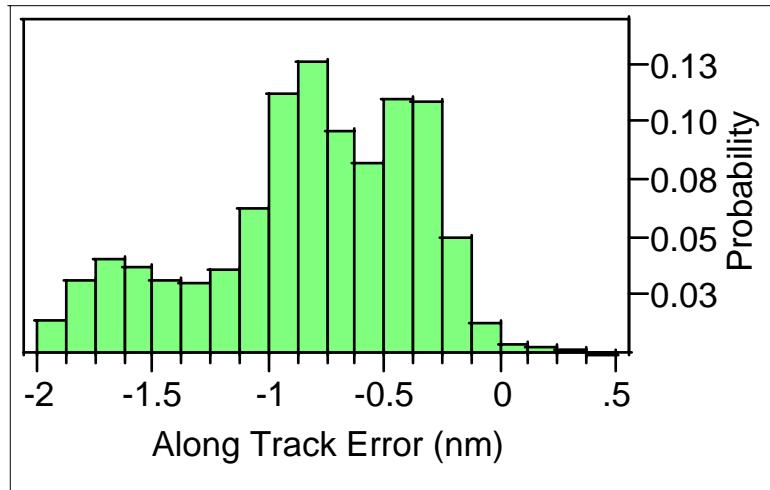


Figure 8: Overall Along Track Error

4.1.5 Overall Altitude Error

The overall altitude error is another signed metric that is symmetric around a population mean of zero, but unlike the other metrics it is measured in feet. The sample mean is 20 feet, which is beyond the accuracy of the data source and is supported by the median of 0 feet. The standard deviation is 190 feet and the 75th and 25th quantiles are 0 and 0 feet, respectively. All indicate a very symmetric distribution around zero nautical miles error. The histogram is not displayed as it is basically a single bar at 0 feet.

4.2 Inferential Statistics

Inferential statistics are methods that go beyond summarizing the sample with an objective to draw conclusions about the population based on the sample information (Devore, 2000). They are used to test for a specific question or series of questions by determining if a given independent variable influences the dependent variable. In this study, the dependent variables include the horizontal, cross track, along track, or altitude errors and the independent variables include the turn status (i.e. the track is within a turn or not), vertical transition status (i.e. track is climbing, descending or level), or altitude interval. It is assumed that the data approximates a normal distribution close enough to substantiate all the tests. Therefore, this section will provide evidence or illustrate the lack of statistical evidence whether a variable influences the HCS tracker's performance.

4.2.1 Tracker Error by Turn Status

It has been proposed that the accuracy of the tracking algorithm is influenced by whether the aircraft is within a turn. In this section, turn status is determined by comparing the course heading change between adjacent HCS track reports after modest smoothing is applied; details provided in (Paglione, et al., 1999). Next, turning and not turning track reports are compared by

their horizontal, cross track, along track, and altitude errors (same errors calculated in Section 4.1). The following Figure 9 illustrates the box plots of these two sample populations. From Figure 9 and Table 2, the difference between the two sample means is 0.11 nautical miles, indicating that the turn status does not appear to influence the accuracy by much, yet the difference is larger than the accuracy limits of the source data (i.e. 0.02 nautical miles).

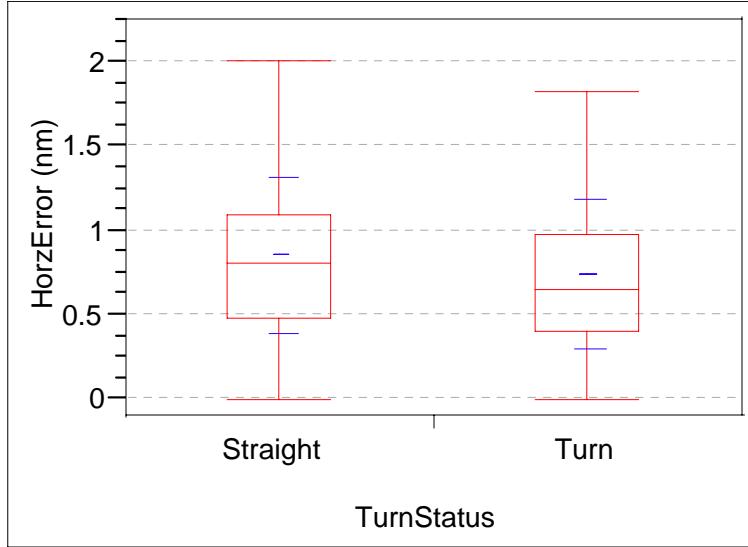


Figure 9: Horizontal Track Error Box Plots by Turn Status

Table 2: Turn Status Error Statistics

		Horizontal Error (nm)		Cross Track Error (nm)		Along Track Error (nm)		Altitude Error (feet)	
Turn Status	Sample Size	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
No Turn	277,069	0.86	0.46	0.00	0.14	-0.84	0.47	20	190
Turn	21,267	0.74	0.44	0.00	0.21	-0.70	0.47	10	220

The subsequent Figure 10, Figure 11, and Figure 12 provide comparison of the two samples for the cross track, along track, and altitude errors. A Student's t test was performed comparing the two sample means. The test indicated that there is a statistically significant effect between the sample means with the horizontal, along track, altitude and even cross track error measurements. Although the cross track error is approximately zero as illustrated in the Table 2, there is a difference within thousandths of a nautical mile. Since thousandths of a nautical mile equate to measurements within tens of feet, these values are below the measuring capability of the source data. The same argument can be made for the altitude error, which differs by approximately 10 feet.

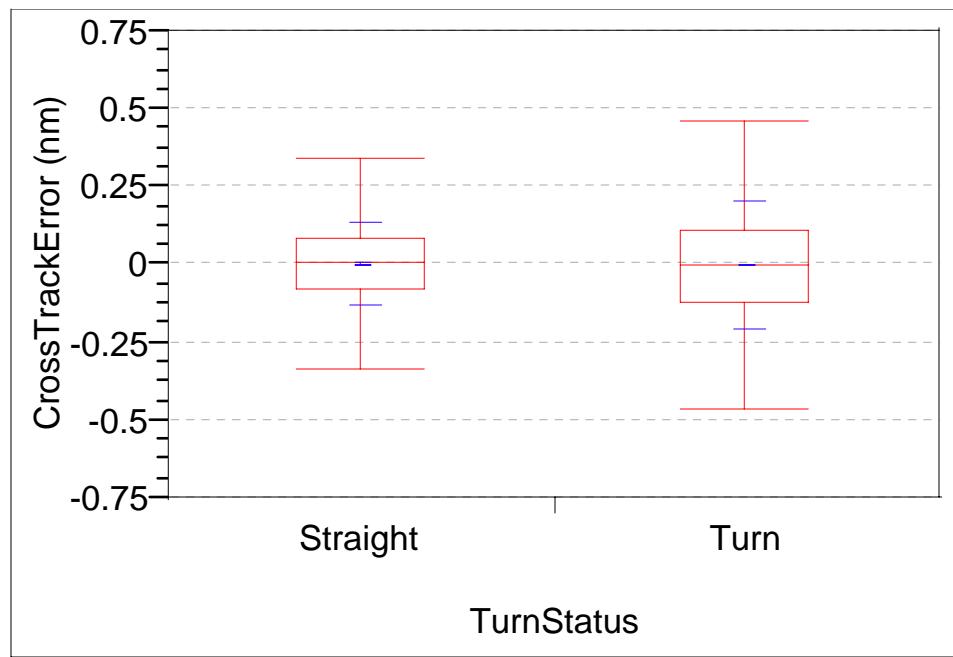


Figure 10 Cross Track Error Box Plot by Turn Status

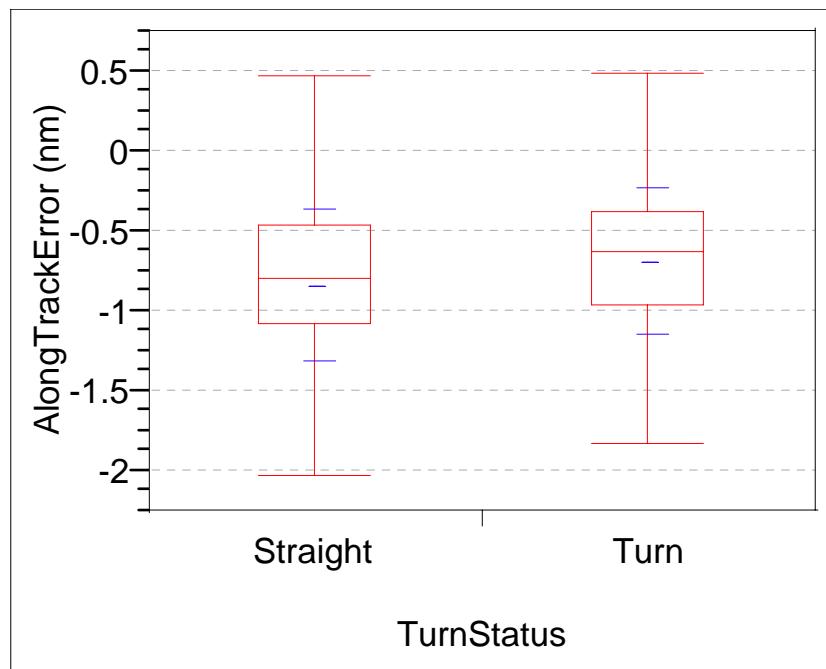


Figure 11 Along Track Error Box Plot by Turn Status

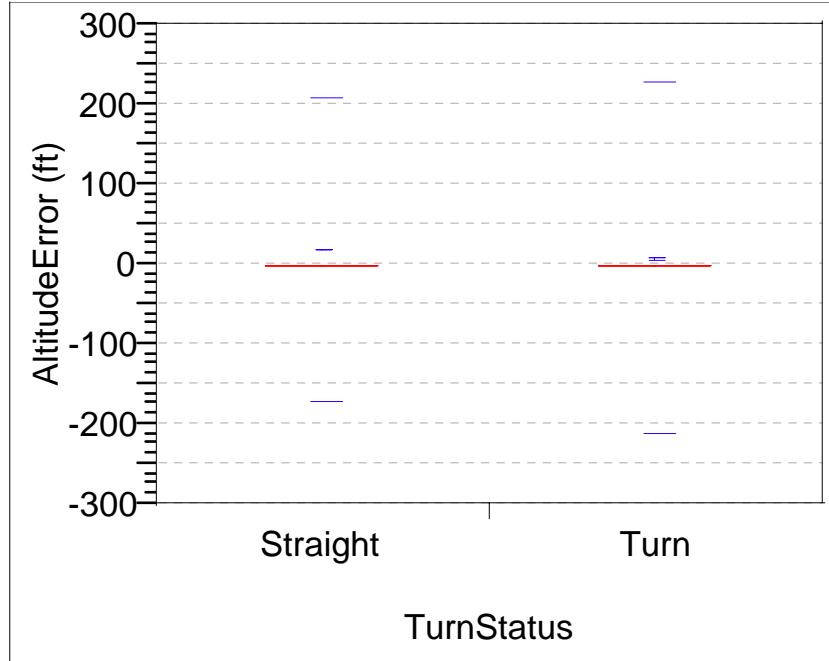


Figure 12 Altitude Error Box Plot by Turn Status

According to Devore (Devore, 2000), “one must be especially careful in interpreting evidence when the sample size is large, since any small departure from [the null hypothesis] will almost surely be detected by a test, yet such a departure may have little practical significance.” Although the differences for cross track and altitude error are statistically significant, the conclusions must be rejected due to the accuracy of the data, which results in an inconclusive comparison for these metrics. For the horizontal and along track errors, there is statistical significance in their differences, but again the practicality of approximately a tenth of a nautical mile is questionable. Hence the results of these tests are inconclusive based on the accuracy limits of the data.

The analysis above for turn status is a reflection of all 1342 sample of flight segments and the 298,336 measurements. From the following histogram illustrated in Figure 13, the distribution of each flight’s sample mean of horizontal error is shown. The spread or standard deviation of the sample means is quite large at 0.31 nm. Thus, the effect of the factor under study, turn status, must be detected within the variability of flights. Another approach could be employed to block out this variability and focus on the objective of this test, namely does turn status impact tracker performance?

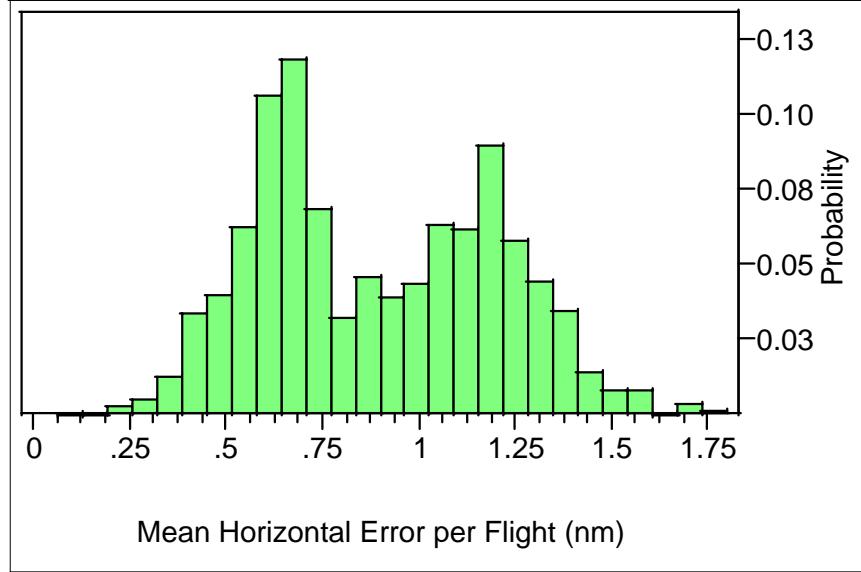


Figure 13: Histogram of Average Horizontal Error per Flight

To successfully block out the variability between flights and focus the test on the turn status, the tracker error needs to be correlated within a flight (Paglione and Charles, 2003). In other words, if a flight had a large tracker error both its track positions in turn and not in turn should be greater than a typical flight and vice versa. A subset, 172 flights, of the 1342 flight segments was selected that had a minimum of 30 measurements each in turn and not in turns. For these 172 flight segments, the sample means of horizontal error for in and not in turns were plotted against each other in Figure 14. This plot illustrates a positive-linear trend between the within flight turning and not turning errors. The graphical result from Figure 14 is verified by a correlation coefficient close to one, which is a statistic that quantifies the linear relationship between two variables. Furthermore, a formal test can be performed to test significance that the correlation between turning and not turning errors for each flight in this study. The test is called the Pearson Correlation Coefficient and for this study has a 0.01 significance when greater than 0.19 or less than -0.19 (Naiman et al. 1995). For this set of flight segments, a strong positive correlation was calculated at 0.79, which is significant. Thus, if the differences within a flight were paired, the precision of the previous test may be improved. For further detail, on why a high correlation translates to an effective paired statistical test and full explanation of the merits of paired versus unpaired approaches see the Appendix Section 8.3.

The pairing of the error metrics was implemented for all four metrics and the results are summarized in Table 3, which provides the average difference between these sample means, the p-value to test the significance of this statistic, and the correlation coefficient for each metric. The results reflect some improvement over the previous test employed. The effect of turning on cross track error was rejected as significant. The difference between horizontal error means was now closer to 0.2 nm versus the previous calculation of about 0.1 nm from Table 2. Similarly, the along track error was strongly significant and now has a difference of 0.2 nm versus the previous calculation of about 0.1 nm. However, even with this improved testing method, the difference between the turning and not turning measurements for the altitude dimension is still inconclusive, but pairing the data per flight has improved the testing in the horizontal dimension. Now, the turning impact on the cross track error can safely be rejected as not significant and the horizontal and along track errors are modestly significant.

An additional benefit was produced by the pairing of the error metrics. The distribution of the mean difference per flight for all four errors followed a Normal Distribution quite nicely. Details are presented in Appendix Section 8.3. This is credited to the Central Limit Theorem, which states that a sufficiently large random sample of variables will produce a mean that is normally distributed (Devore, 2000). This is exactly what was accomplished by taking sample means of 30 or larger measurements of the turning/not turning measurements and calculating their differences.

Table 3: Within Flight Turn Status Paired Statistical Test Results¹

		Horizontal Error (nm)		Cross Track Error (nm)		Along Track Error (nm)		Altitude Error (feet)		
	Sample Size	Mean Diff	P-value	Mean Diff	P-value	Mean Diff	P-value	Mean Diff	P-value	
Metrics	172	-0.16	0.0001	0.00	0.76	0.19	0.0001	-10	0.0325	
Correlation	0.79		0.37		0.78		0.73			

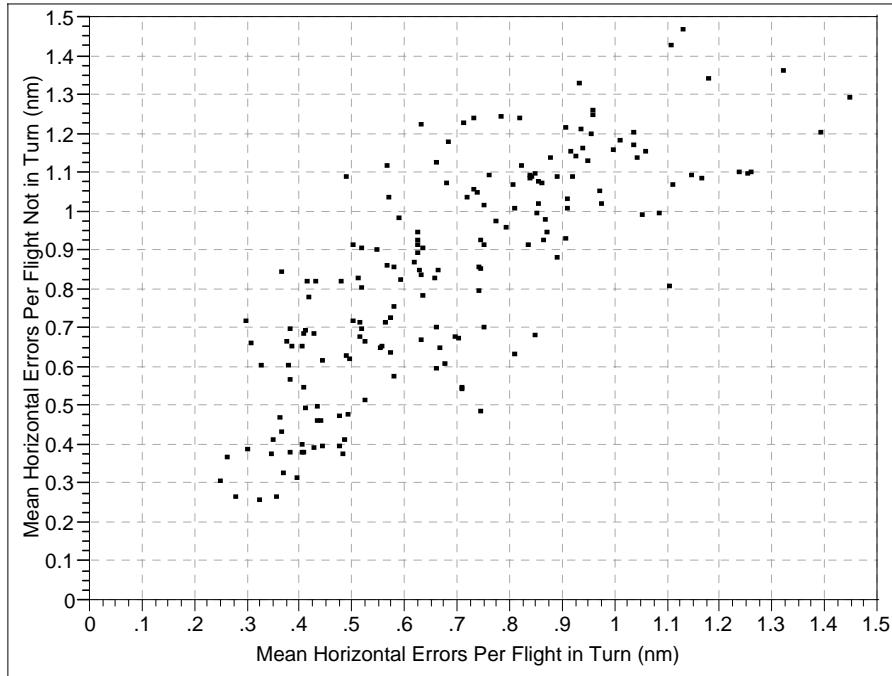


Figure 14: Mean Horizontal Errors in Turn and Not in Turn (nm)

In summary, the differences in error for turning and not turning measurements were calculated using two different statistical tests: one that includes the variability of flight segments and a second method where flight variability was blocked using a paired data approach. The pairing method is shown to provide superior test results in the horizontal dimension, but for the altitude errors both prove inconclusive due the small total effect of the turn status and inherent accuracy of the data. The process of detecting an aircraft position was turning or not is given in (Paglione,

¹ From (Lehman, et al., 2005), the p-value indicates the “probability that you would obtain the present results if the null hypothesis were true.” As a result, a small p-value (say less than 0.05) allows you to safely reject the null hypothesis.

et al., 1999). The algorithm uses the HCS track data to calculate the turn, but as reported in Section 4.1.1 the tracker has significant errors itself. To improve sensitivity further, AMTWG plans to repeat the turn status detection using the GSGT simulated position reports. This is proposed for a future study.

4.2.2 Tracker Error by Vertical Transition

Another possible influence in the accuracy of the tracking algorithm is transitioning vertically. In this section, a vertical transition is determined by comparing the altitude change between adjacent HCS track reports after modest smoothing is applied; details provided in (Paglione, et al., 1999). Next, vertical transitioning and level track reports are compared by their horizontal, cross track, along track, and altitude errors (same errors calculated for turn status in Section 4.2.1). The following Figure 15 illustrates the box plots of the horizontal errors of these two sample populations. Level refers to level flight, and transition refers to measurements with track data determined to changing vertically (i.e. climbing or descending). From Figure 15 and Table 4, the difference between the two sample means is 0.03 nautical miles, indicating that the vertical transition does not appear to have an impact on accuracy by much, if at all.

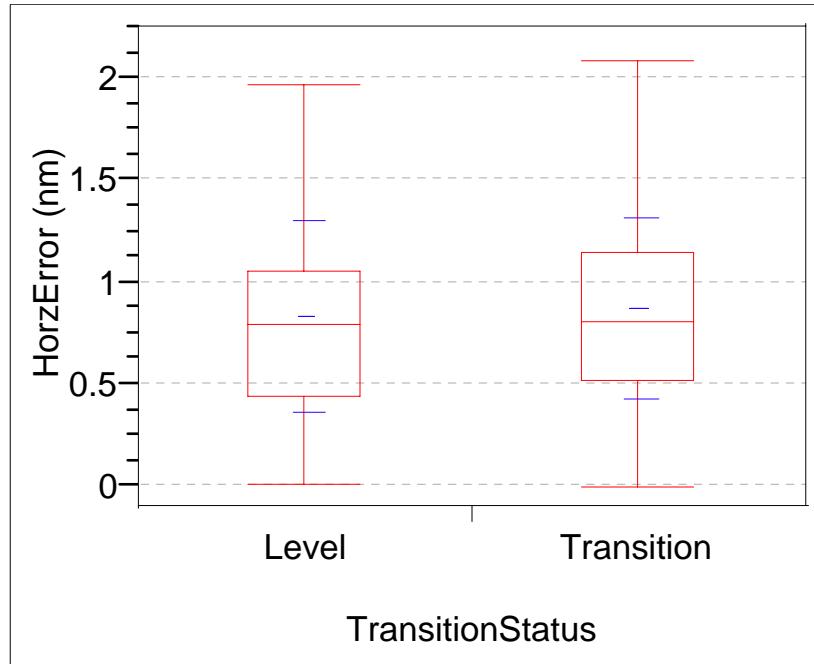


Figure 15 Horizontal Track Error Box Plots by Vertical Transition

Table 4: Vertical Transition Error Statistics

		Horizontal Error (nm)		Cross Track Error (nm)		Along Track Error (nm)		Altitude Error (feet)	
Trans. Status	Sample Size	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Level	195788	0.84	0.47	0.01	0.14	-0.82	0.48	0	40
Trans.	102548	0.87	0.44	0.00	0.14	-0.85	0.45	50	320

The subsequent Figure 16, Figure 17, and Figure 18 provide comparison of the two samples for the cross track, along track, and altitude errors. As in Section 4.2.1, a Student's t test was performed comparing the two sample means. The test indicated that there is a statistically significant effect between the sample means with the horizontal, along track, altitude and even cross track error measurements. Although significant, the differences are within hundredths of a nautical mile. Since hundredths of a nautical mile equate to measurements within hundreds of feet, these values are close to if not below the measuring capability of the source data. For the altitude error, which differs by approximately 50 feet, the difference is below the accuracy level of the data (i.e. less than 100 feet).

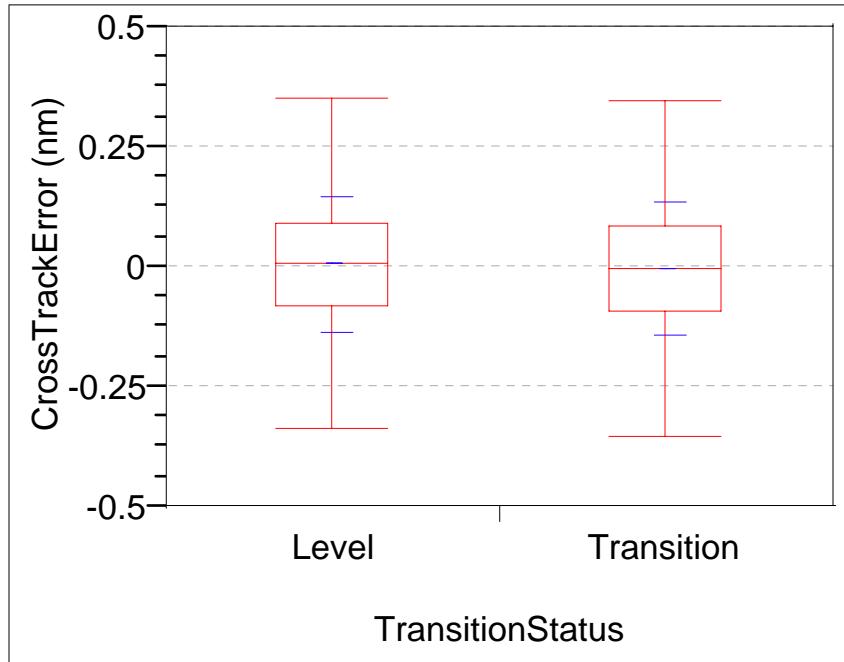


Figure 16 Cross Track Error Box Plot by Vertical Transition

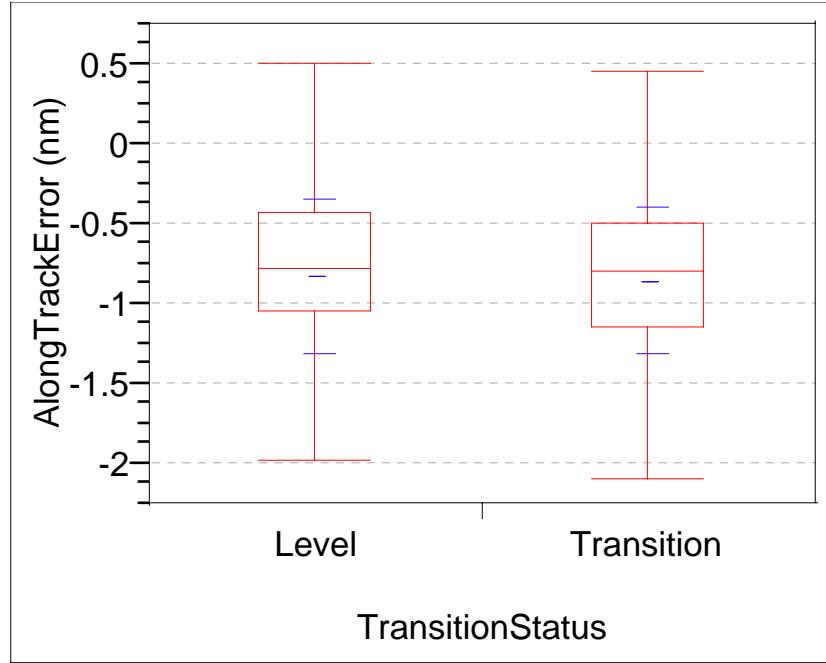


Figure 17 Along Track Error Box Plots by Vertical Transition

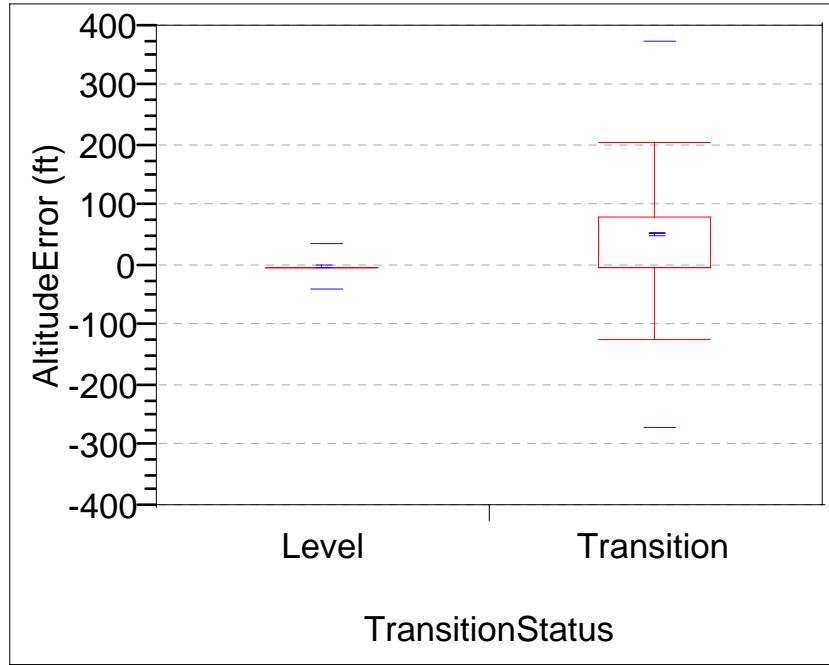


Figure 18 Altitude Error Box Plots by Vertical Transition

As in the turn status tests of Section 4.2.1, the test was repeated by pairing the flight's sample mean of vertically transitioning and level measurements. After selecting only the flights with at least 30 measurements for each category (i.e. transitioning and not transitioning), 905 flights remained for analysis. Table 5 lists the results. Like the previous analysis above, the impact of

transitioning status on the tracker accuracy, on altitude error does not indicate a practical significance (still less than 100 feet) even though it had statistical significance. For the horizontal dimension, cross track error can now be rejected. Also, for the differences of the horizontal and along track errors, even though small, they are about four times larger than the source data's accuracy. Like turn status, the pairing did produce normally distributed data sets that validated the use of the paired data statistical test.

The transitioning status is determined by calculating the difference in altitude change between adjacent HCS track reports. If this calculation was repeated using the ground truth simulator positions, it is expected to provide evidence of a larger impact on tracker error. This remains for a future study.

Table 5: Within Flight Vertically Transitioning Status Paired Statistical Test Results

		Horizontal Error (nm)		Cross Track Error (nm)		Along Track Error (nm)		Altitude Error (feet)	
	Sample Size	Mean Diff	P-value	Mean Diff	P-value	Mean Diff	P-value	Mean Diff	P-value
Metrics	905	-0.09	0.0001	0.00	0.20	0.08	0.0001	40	0.0001
Correlation		0.80		0.57		0.79		0.26	

4.2.3 Tracker Error by Altitude Interval

Different aircraft frames and categories operate at different altitudes with different speed profiles and weather influence. Due to this, it was speculated that altitude might indirectly influence the tracker's performance. For this section, the data sets were categorized into the following altitude bands: 0 to 10,000 feet, 10,000 to 18,000 feet, 18,000 to 29,000 feet, 29,000 to 40,000 feet, and above 40,000 feet. As listed in Table 6, the data set is somewhat biased with almost 42 percent of the measurements being sampled from the altitude band 29,000 to 40,000 feet. However, the data still exhibits patterns of performance. These patterns are presented in Table 6 where each error metric's sample mean and standard deviation is listed. The results for horizontal, cross, along, and vertical errors are illustrated as box plots in Figure 19, Figure 20, Figure 21, and Figure 22, respectively.

Table 6 Altitude Band Error Statistics

		Horizontal Error (nm)		Cross Track Error (nm)		Along Track Error (nm)		Altitude Error (feet)	
Altitude Band	Sample Size	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
0-100	27031	0.54	0.26	-0.01	0.16	-0.50	0.28	40	210
100-180	45736	0.74	0.36	0.00	0.15	-0.72	0.38	40	260
180-290	85952	0.87	0.43	0.00	0.14	-0.85	0.44	20	240
290-400	123932	0.95	0.51	0.01	0.14	-0.93	0.52	10	120
400-	15685	0.81	0.43	0.02	0.13	-0.79	0.44	0	70

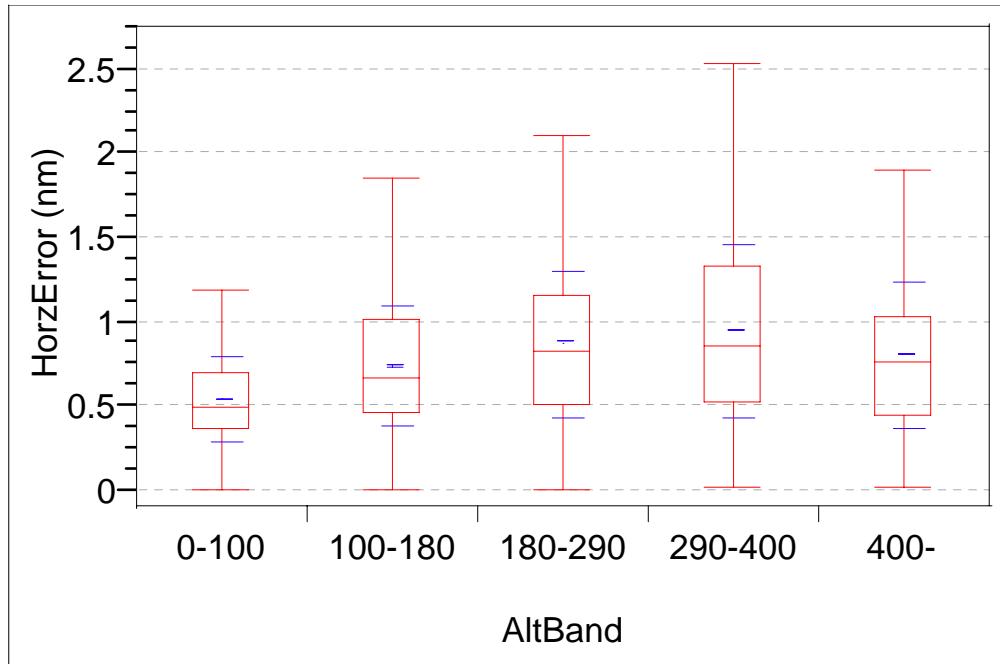


Figure 19 Horizontal Track Error Box Plots by Altitude Band

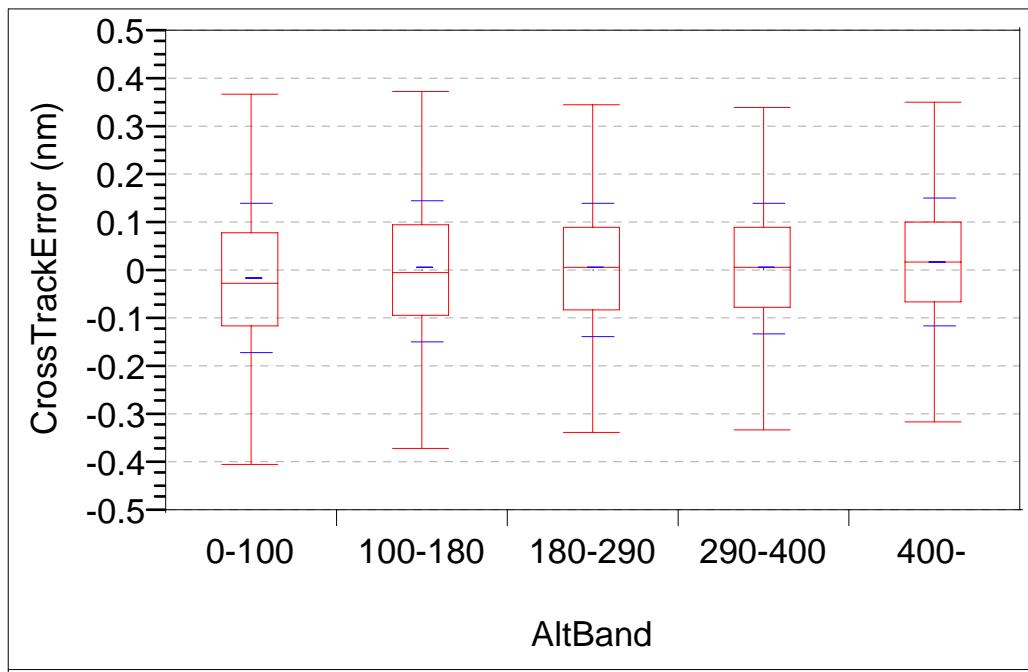


Figure 20 Cross Track Error Box Plots by Altitude Band

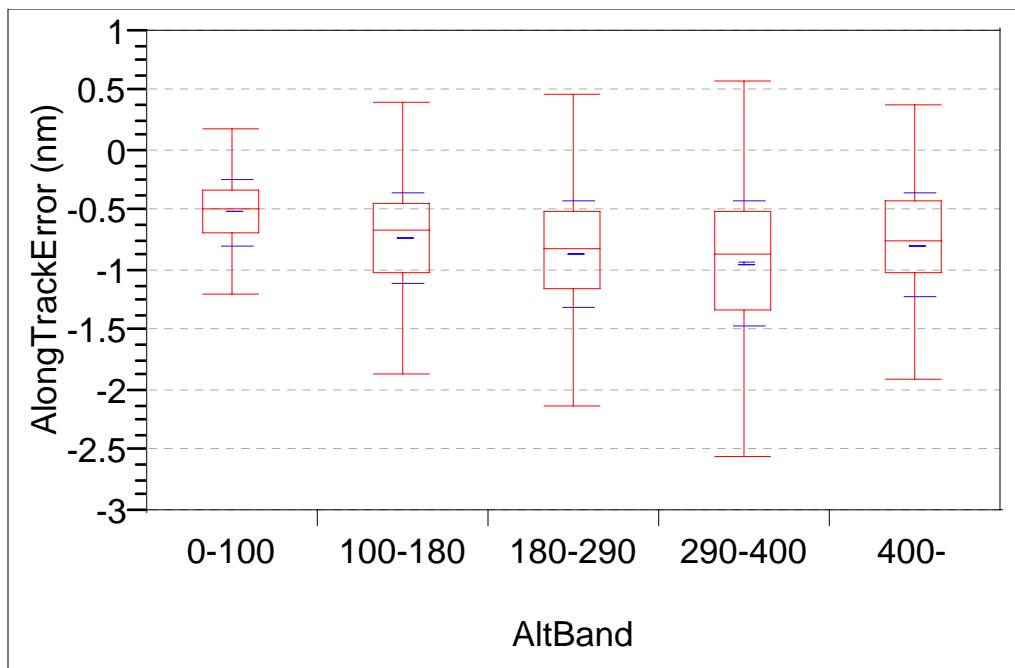


Figure 21 Along Track Error Box Plots by Altitude Band

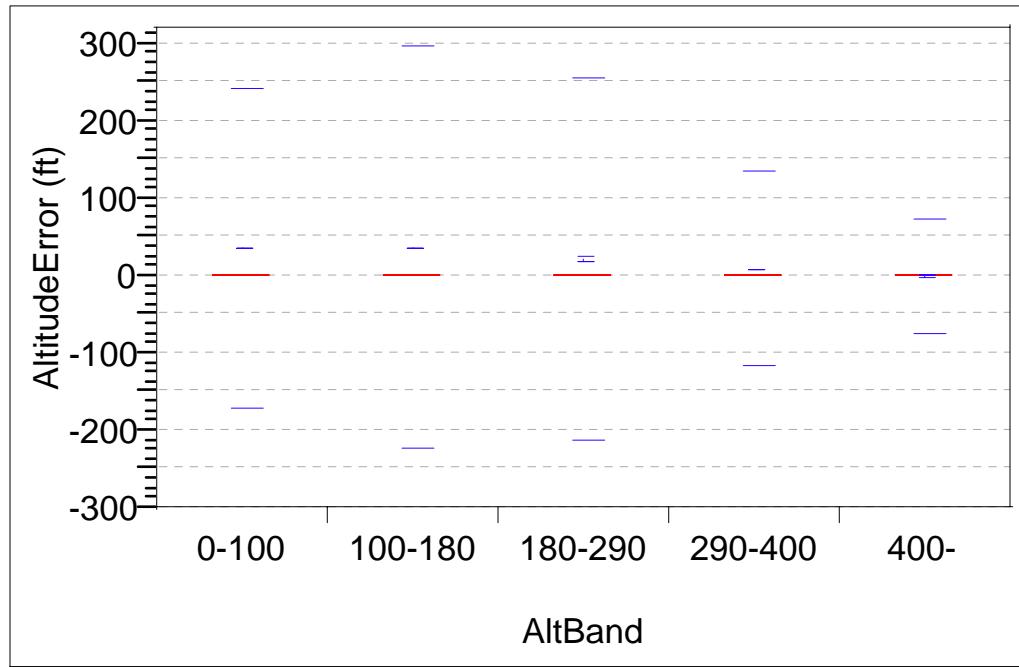


Figure 22 Altitude Error Box Plots by Altitude Band

Horizontal track error in Figure 19 and along track error in Figure 21 both illustrate a rise in the sample mean and standard deviation of the data as the altitude band is increased until 40,000 feet. The sample means show rather flat differences as the altitude band is increased for the cross track error and the altitude error, shown in Figure 20 and Figure 22, respectively, while the standard deviations decrease. By applying the Tukey-Kramer statistical test for differences between

means, the differences are statistically significant for the horizontal and along track errors. After examining the data, it is evident that the impact is modest but has some practical significance. The largest of either the horizontal or along track error difference is about 0.4 nautical miles, which is somewhat larger than the 0.02 nautical mile precision of the data source. The test confirmed that the altitude error did not significantly change as a function of altitude band. The mean cross track error had some significant changes as a function of altitude band, especially in the lower altitude bands. Nonetheless, examining the data results in a similar conclusion. The differences of the cross track error in hundredths of a nautical mile have no practical significant. Although the study does provide some statistical evidence to support that altitude does have an impact on the tracker's performance, the magnitude is less than data set's accuracy. Furthermore, AMTWG cautions that altitude could also be a composite indicator for other more influential factors such as aircraft speed and aircraft type.

4.3 Illustrative Sample Flights

To complement the previous Sections 4.1 and 4.2 that reported statistical analyses on all the flights, this section presents a detailed overview of three flights within the study. The first sample flight shows the arrival phase of flight. It captures a series of interim altitudes issued by the controller during its descent to handoff to terminal control. For sample flight #2, the flight's climb rate stair steps during the climb 1. This is due to the Air Traffic Controller issuing interim altitude clearances to the aircraft as was verified by DR&A analysis of the HCS CMS messages. This aircraft flies a relatively straight path as it climbs to altitude. The sample flight #3 is a typical cruising flight with typical errors, except a glitch appearing in the altitude positions.

4.3.1 Sample Flight One

The sample flight #1 is an arrival flight, illustrating a descent in the ZDC. A 360 degree turn occurs during the aircraft's descent and the maximum horizontal error goes to 1.4 nm. The RMS for horizontal error for this flight is 1.03 nm as shown in Table 7, which is slightly larger than the overall horizontal error for all 1500 flights as stated in Table 1. The altitude errors for sample flight one as shown in Table 7 are slightly larger than the overall RMS value as well. The aircraft is descending and issued a series of interim altitude commands by ATC, which contributes to the altitude plateaus in the aircraft's descent

4.3.1.1 Data Collection and Reduction

The GSGT simulated scenario was used to drive the HCS in the WJHTC's IIF. The data being a sample collected in Leesburg Virginia (ZDC) ARTCC on March 17, 2005. This resulted in 87 track reports recorded from the HCS in the I2F Laboratory. The track started at 20:12:55 UTC and ended at 20:34:19, covering an interval of 21 minutes 24 seconds of the flight. Due to data reduction processing through interpolation, the 87 positions expand to 101 track positions. The HCS track reports are nominally separated by 12 second intervals and the data processing reduces it to 10 second intervals. For the GSGT simulated positions, the data is nominally separated by one second intervals. For this flight, GSGT generated 1365 positions starting at 20:11:22 UTC and ending at 20:34:06 UTC. After the initial data reduction, these GSGT positions are reduced to 136 position reports starting at 20:11:30 UTC and ending 20:34:00 UTC.

For Sample Flight #1, the aircraft is a McDonnell Douglas, MD82, which is a large twin engine jet up to 255,000 lbs max takeoff weight. The aircraft has a climb rate of 3500 feet per minute and a descent rate of 3000 feet per minute. The aircraft is flying from Chicago O'Hare Airport in Chicago, Illinois to Ronald Reagan Washington National Airport (DCA) in Washington DC. The flight segment captured for analysis shows the arrival phase of flight into DCA airport.

4.3.1.2 Comparison

Starting with the first HCS track report, the simulated positions from GSGT were sampled every 10 seconds for the given aircraft. This resulted in exactly 100 error measurements for Sample Flight #1. The GSGT positions (in blue) and associated HCS track reports (in red) are plotted using an ACB-330 application called the Trajectory Graphical User Interface or TrajGui in Figure 23 and in Figure 24.

4.3.1.3 Data Analysis

The aircraft descent is not continuous but has a number of stair steps in the descent path. A circular maneuver, illustrated in Figure 23, is flown, presumably to cause a time delay as the flight descends. The RMS horizontal tracking error for this sample is 1.03 nm and the RMS for altitude error is 280 feet. The altitude versus time is shown in Figure 24.



Figure 23 Radar XY Plot of Sample Flight One



Figure 24 Time Altitude Plot Sample Flight One

The point statistics for the four error metrics calculated for this flight is listed in Table 7. As defined in Section 3.3.2, the horizontal error is about 1 nm in mean and RMS. The error is mainly due to the along track error (or time delay). From Table 7, the signed mean cross track error is close to zero and signed/RMS statistics close to 0.2 nm. However, the along track error is significantly larger at 0.8-1 nm.

Table 7: Error Summary for Sample Flight One

		Horizontal Error (nm)		Cross Track Error (nm)		Along Track Error (nm)		Altitude Error (feet)	
Type	Sample Size	Mean	RMS	Mean	RMS	Mean	RMS	Mean	RMS
Signed	100	0.92	1.03	-0.06	0.22	-0.81	1.00	100	280
Unsigned				0.16		0.88		110	

These results are further illustrated graphically in the following histograms. Figure 25 depicts the distribution of the horizontal error. Figure 26 depicts the cross track error, which is slightly skewed negative. Figure 27 depicts the along track error that is very much skewed negative with a peak close to -1.0 nm.

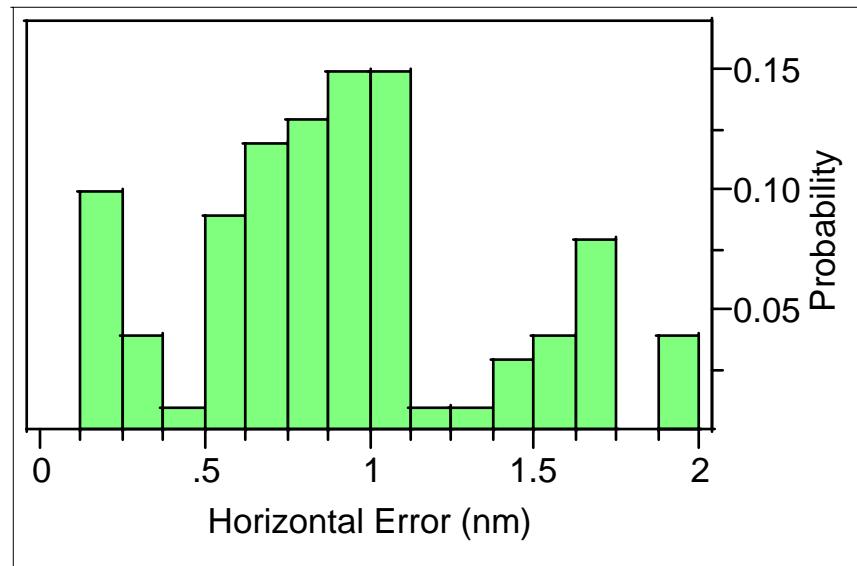


Figure 25: Horizontal Track Error for Sample Flight One

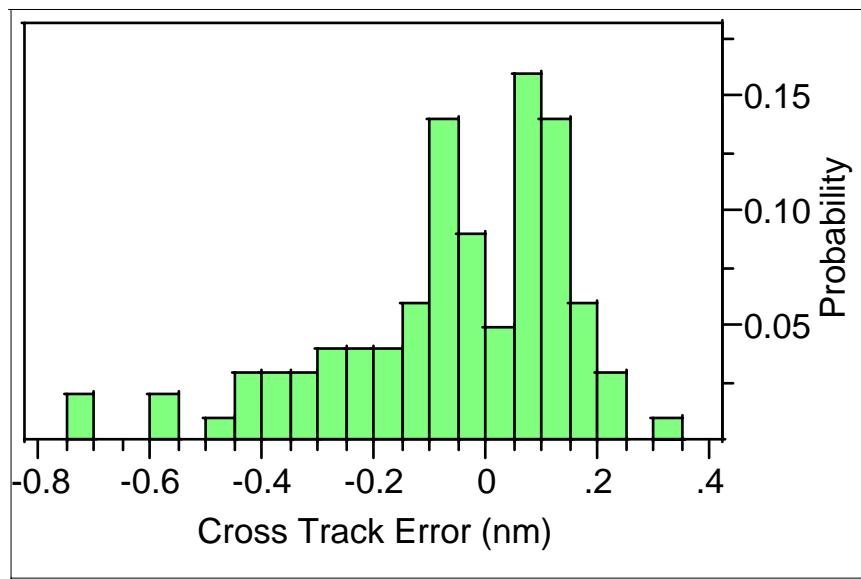


Figure 26: Cross Track Error for Sample Flight One

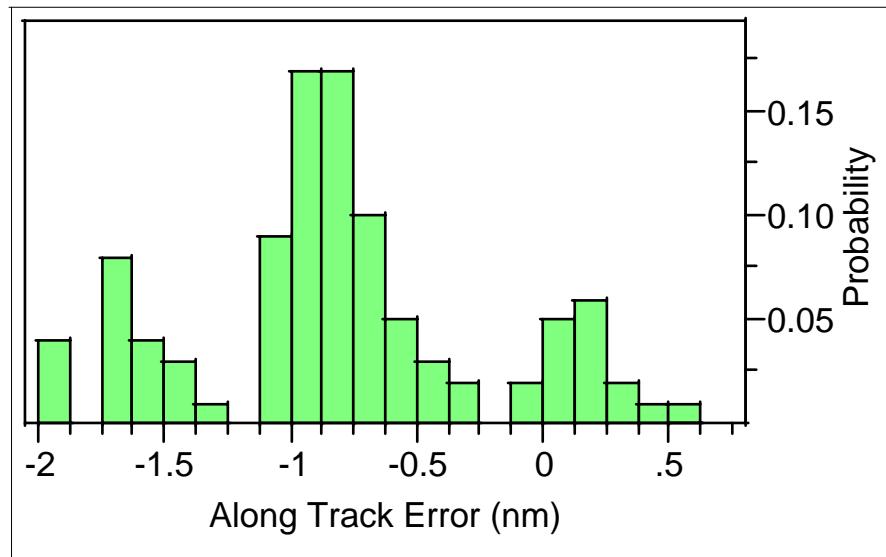


Figure 27: Along Track Error for Sample Flight One

The distribution of Sample Flight #1's altitude error is as shown in Figure 28. The altitude error is strongly peaked at 0 feet error. The errors are spread out, mainly positive from 0 to 1000 feet.

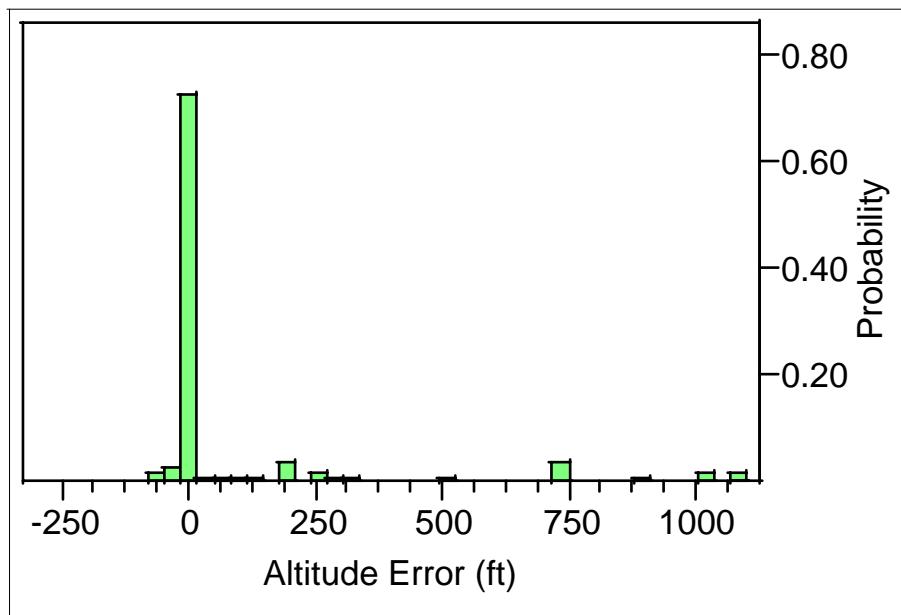


Figure 28: Altitude Error for Sample Flight One

4.3.2 Sample Flight Two

Illustrated in Figure 29, the flight segment representing sample flight two is flying practically a straight path without any significant turns. This sample flight was selected to illustrate how the tracking measurements are generated for a flight segment with smaller than average amounts of error. The horizontal tracking error is small for this sample flight compared to the overall RMS horizontal values, while the altitude errors for this flight are slightly larger than the overall RMS altitude error. The larger altitude error may be indicative of the tracking performance during a departure (see Figure 30). The flight is issued interim altitude commands by the air traffic controller which contributes to the altitude plateaus in the aircraft's ascent.

4.3.2.1 Data Collection and Reduction

As described in the previous sample flight, the GSGT simulated scenario was used to drive the HCS in the WJHTC's I2F Laboratory. This resulted in 79 track reports recorded from the HCS in the I2F Laboratory. The track started at 20:35:55 UTC and ended at 20:51:31, covering an interval of 15 minutes 36 seconds of the flight. Due to data reduction processing through interpolation, the 79 positions expand to 94 track positions. The HCS track reports are nominally separated by 12 second intervals and the data processing reduces it to 10 second intervals. For the GSGT simulated positions, the data is nominally separated by one second intervals. For this flight, GSGT generated 960 positions starting at 20:34:40 UTC and ending at 20:50:39 UTC. After the initial data reduction, these GSGT positions are reduced to 136 position reports starting at 20:11:30 UTC and ending 20:34:00 UTC.

For Sample Flight #2, the aircraft is a Cessna, C560, which is a small twin engine jet with up to 41,000 lbs max takeoff weight. The aircraft has a climb rate of 6000 feet per minute and a descent rate of 3500 feet per minute. The aircraft is flying from Baltimore-Washington Int'l Airport (BWI) in Baltimore, Maryland to Palwaukee Municipal Airport in Chicago's Prospect Heights in Illinois. The captured flight segment is during the aircraft's departure climb. The aircraft's climb profile has several stair steps due to the air traffic controller's instructions and the issuing of several interim altitude commands.

4.3.2.2 Comparison

Starting with the first HCS track report, the simulated positions from GSGT were sampled every 10 seconds for the given aircraft. This resulted in a trajectory of 96 positions sampled at 10 second intervals and exactly 88 error measurements. In Figure 29 and in Figure 30, the GSGT positions (in blue) and associated HCS track reports (in red) are plotted using the ACB-330's TrajGui application.

4.3.2.3 Data Analysis

The results are summarized in Table 8. For Sample Flight #2, the mean horizontal error is 0.55 nm with a RMS value of 0.57. The cross track RMS value is 0.14 nm, which is comparable to the overall result listed in Table 1. The along track and altitude errors are 0.56 nm and 230 feet, respectively. The along track error is comparably lower than the overall along track error of 0.96 nm, but the altitude error's RMS is about 50 feet larger. The altitude error is a direct result of the climb profile, as shown in Figure 30. It has several steps during its departure. This is possibly a result of the several ATC interim altitude clearances found in the recorded CMS messages for this flight segment. The descriptive statistics are supported by histograms illustrating the distributions of error measurements in Figure 31 to Figure 34.

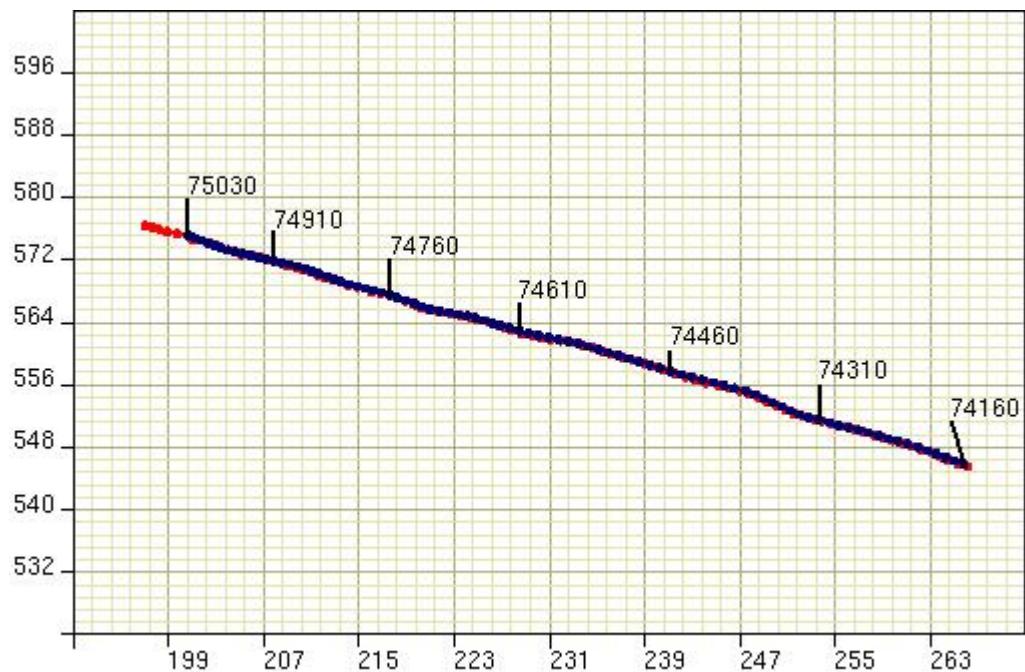


Figure 29: Radar XY Flight Path of Sample Flight Two

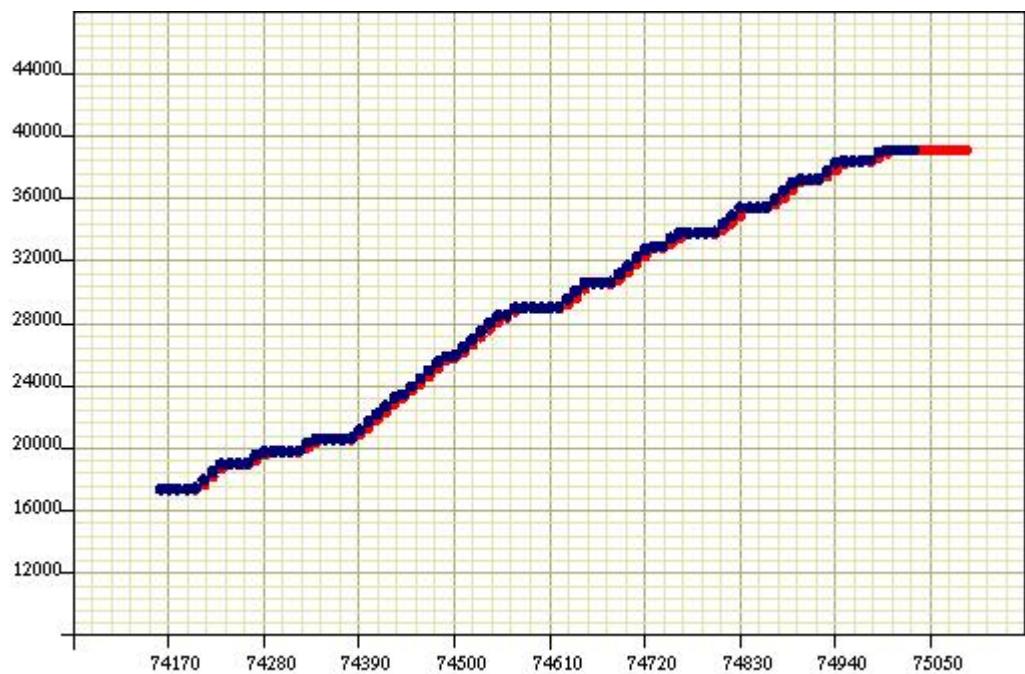


Figure 30: Time Altitude Flight Path of Sample Flight Two

Table 8: Error Summary for Sample Flight Two

Type	Sample Size	Horizontal Error (nm)		Cross Track Error (nm)		Along Track Error (nm)		Altitude Error (feet)	
		Mean	RMS	Mean	RMS	Mean	RMS	Mean	RMS
Signed	88	0.55	0.57	-0.11	0.14	-0.53	0.56	-170	
Unsigned				0.12		0.53		170	230

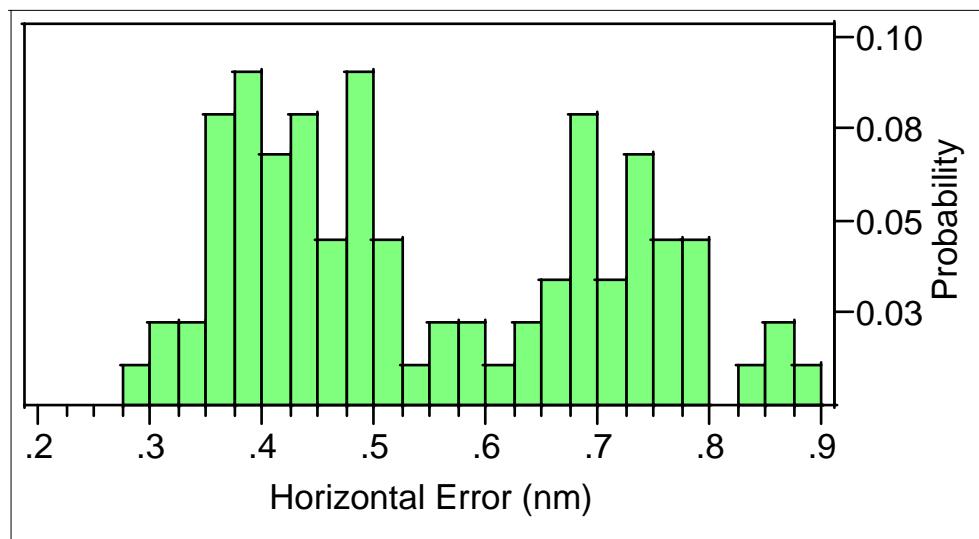


Figure 31: Horizontal Error for Sample Flight Two

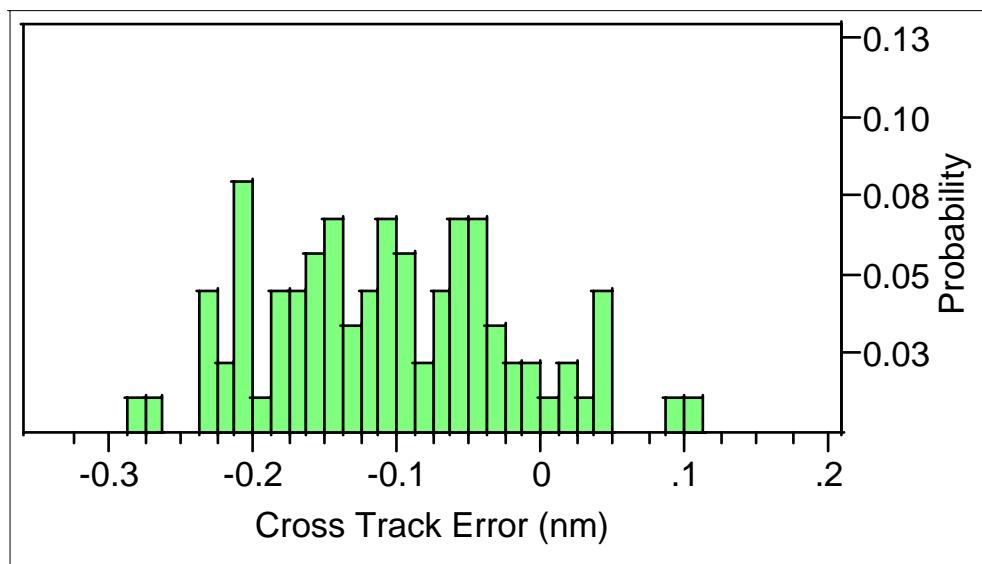


Figure 32: Cross Track Error for Sample Flight Two

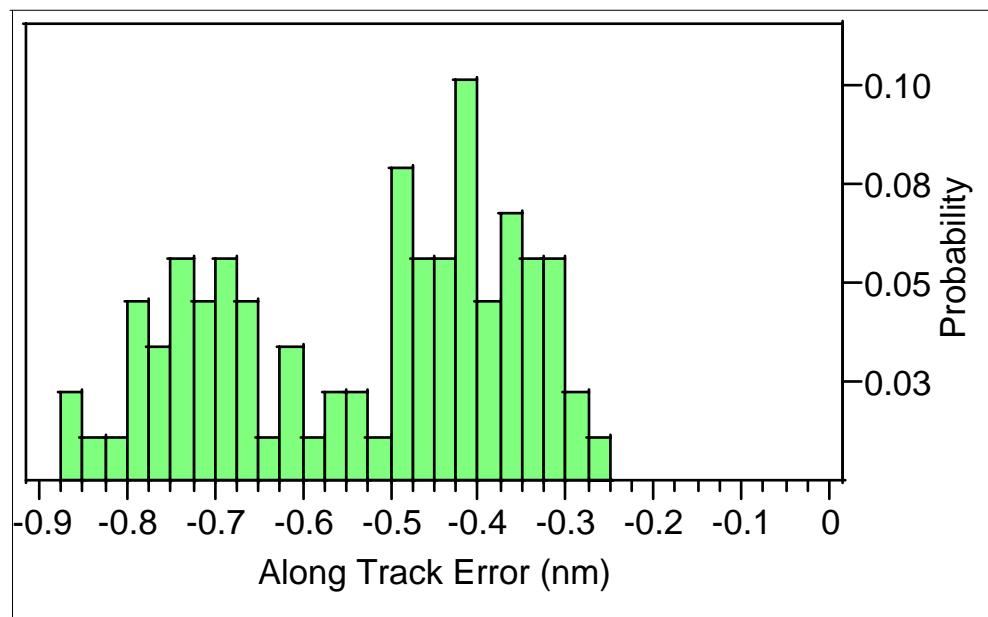


Figure 33: Along Track Error for Sample Flight Two

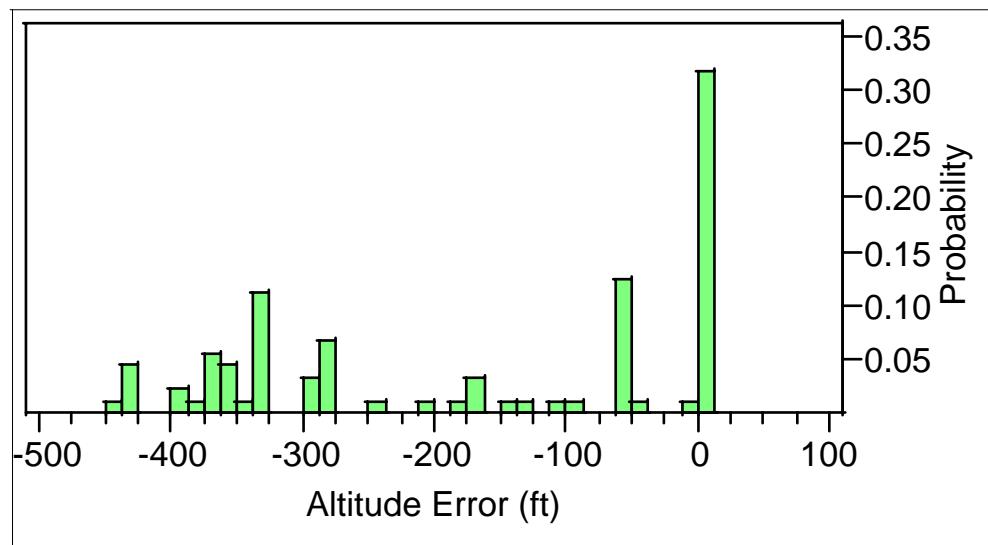


Figure 34: Altitude Error for Sample Flight Two

4.3.3 Sample Flight Three

Sample Flight #3 contains an altitude anomaly that reveals the processing of the GSGT simulation and HCS tracking applied in this study. The flight segment has relatively small tracking errors with only one very shallow turn and cruises at FL300 for most of the flight. However, a strange anomaly whereby the aircraft climbs about 500 feet and descends 1000 feet all within a five minute period before returning to FL300, illustrates some properties of the simulation and processing.

4.3.3.1 Data Collection and Reduction

As described in Section 2, the GSGT simulator sampled the original HCS SAR track reports at 1-minute intervals. For this sample flight, GSGT had 3238 position reports at one second intervals starting at 19:06:58 and ending at 20:00:55. The data reduction process sampled this data on 10 second intervals and produced 324 position reports starting at 19:07:00 and ending at 20:00:50, as expected. The HCS track data generated and recorded by the IIF Laboratory staff and reduced by AMTWG ultimately produced 318 track reports starting at 19:08:10 and ending at 20:01:00, resulting in a flight duration of 53 minutes.

The aircraft is a Boeing B739, which is a large twin jet with a 255,000 lbs maximum takeoff weight. The aircraft has a climb rate of 4000 feet per minute and a descent rate of 4000 feet per minute. The aircraft is flying from Newark Liberty International Airport in Newark, New Jersey to George Bush Intercontinental Airport in Houston, Texas.

4.3.3.2 Comparison

The reduced 324 GSGT positions and the 318 HCS track positions produced 317 measurements, since each one of these overlapping positions would be sampled at least once. In Figure 35 and Figure 36, the GSGT positions (in blue) and associated HCS track reports (in red) are plotted using the ACB-330's TrajGui application for the horizontal (x-y) and time versus altitude dimensions, respectively.

4.3.3.3 Data Analysis

As listed in Table 9, the 317 measurements exhibit smaller than average errors. The horizontal error is 0.6 nm on average and has a RMS of 0.67 nm. The mean cross track error is practically zero and RMS is 0.11 (slightly smaller than the overall value). The along track error is negatively skewed as depicted in its histogram in Figure 40 and close to the average value at -0.58 nm. The cross track error is very symmetric with a 0 mean and median as depicted in Figure 39.

The interesting error for Sample Flight #3 is the altitude dimension, where an anomaly occurs as shown in Figure 36 and magnified in Figure 37. The altitude slightly spikes and descends then levels back at the cruising altitude. Further investigation, determined the original recorded track altitude exhibited the same behavior and the processing retained the anomaly. In other words, if the anomaly occurs over the 1-minute sampling interval used by GSGT, then an anomaly such as this will be repeated.

There is no explanation for the anomaly besides altimeter malfunction. There were no recorded clearances around the time of the event. More verbal clearances may have been issued, since the recording indicates the flight was cleared to fly at FL320 until 19:05:03 when it was cleared to

descend and maintain at FL300. For the duration of the sample, the data indicates the flight was correctly cruising (for most of the time) at FL300.

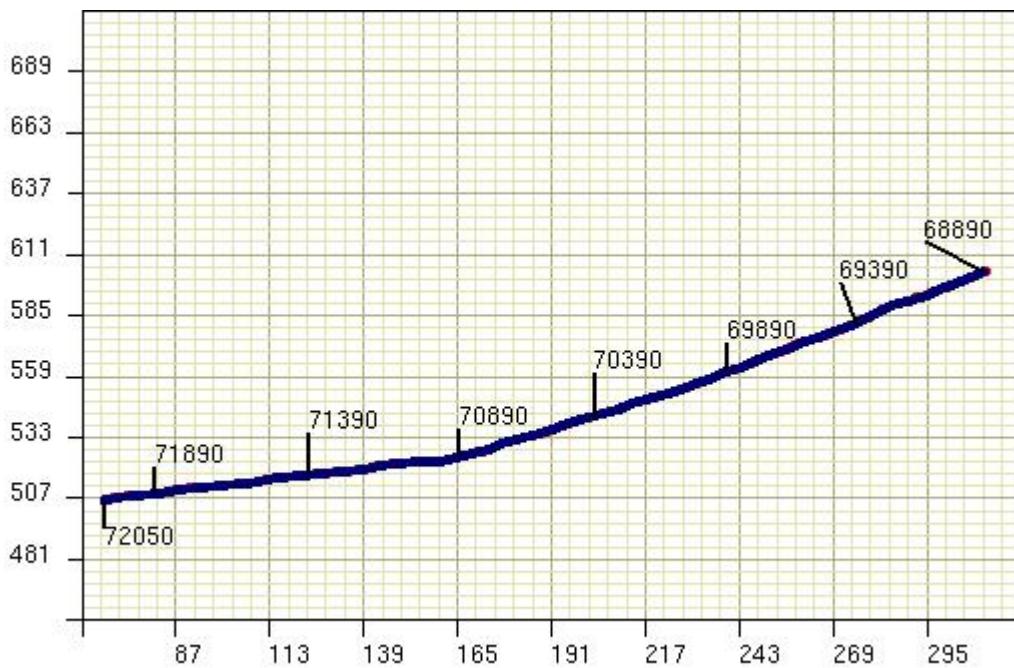


Figure 35: Radar XY Plight Path of Sample Flight Three



Figure 36: Time Altitude Flight Path of Sample Flight Three



Figure 37: Time Altitude Zoom of Flight Path of Sample Flight Three

Table 9: Error Summary for Sample Flight Three

		Horizontal Error (nm)		Cross Track Error (nm)		Along Track Error (nm)		Altitude Error (feet)	
Type	Sample Size	Mean	RMS	Mean	RMS	Mean	RMS	Mean	RMS
Signed	317	0.60	0.67	0.00	0.11	-0.58	0.66	0	80
Unsigned				0.09		0.59		10	

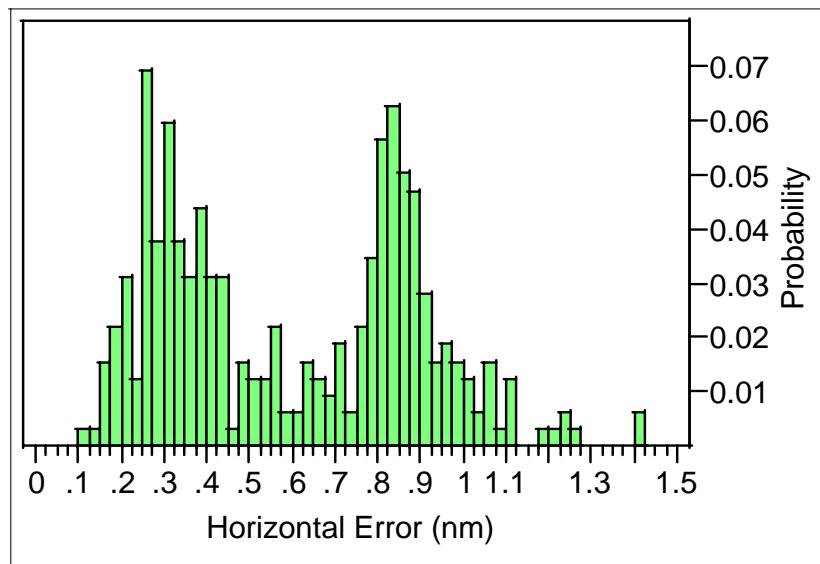


Figure 38: Horizontal Track Error for Sample Flight Three

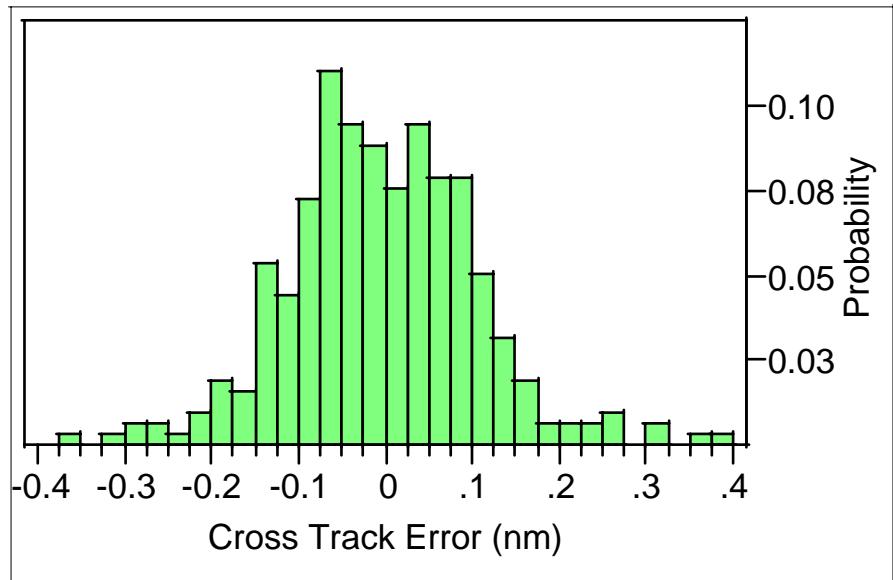


Figure 39: Cross Track Error for Sample Flight Three

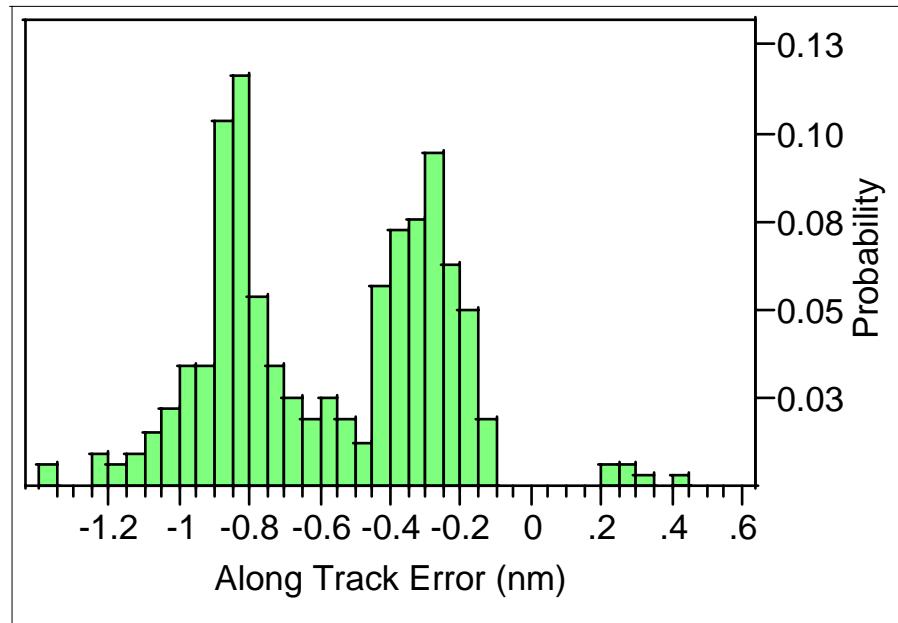


Figure 40: Along Track Error for Sample Flight Three

5 Summary and Conclusions

A recording of approximately four hours of air traffic data was collected in ZDC on March 17, 2005 with approximately 1500 flight segments. AMTWG supplied this data to the IIF Laboratory that ran simulation using the GSGT application with an induced radar noise deviation of +/- 2 ACPs. The simulation produced the HCS tracks reports and GSGT positions. The GSGT positions were considered the actual path the aircraft flew in which the HCS track positions were measured against. A series of data processing steps were run comparing the GSGT positions to the HCS track reports. This reduced the sample to 1342 flight segments and resulted in 298,336 measurements calculated. For each of these measurements four metrics were calculated and stored in a relational database. These metrics are presented in Section 3.3.2 and in detail in Appendix Section 8.1. In summary, they include horizontal error, its two orthogonal components cross and along track error, and altitude error.

This representative sample of operational data allowed the AMTWG along with the companion report titled: "Comparison of Host Radar Tracks to Aircraft Positions from the Global Positioning Satellite System," (Ryan and Paglione, 2005) to estimate the performance of the existing ATC tracking function. As first implemented in the companion report, the same descriptive and similar inferential statistics were applied with compatible results. The main difference is the prior study used global positioning satellite (GPS) positions as ground truth, and this study utilized the GSGT simulator. The GPS based study provides an accurate measure of HCS tracker performance but is very costly to repeat and thus can only be indirectly used to evaluate ERAM. The current simulator based study could be modified for input into ERAM providing a direct comparison. Therefore, both approaches complement each other. The previous GPS based study provides the absolute accuracy results and the current study is available for potential use in ERAM.

As presented in Section 1.1, the motivation for this study was to support the ERAM Test Program to address COI 1.0 that requires that ERAM to perform with at least the same effectiveness as the current NAS. This analysis supports this testing by providing a dataset and analysis methodology to later apply to the ERAM system. It advances the ERAM metrics development documented in AMTWG Implementation Plan (WJHTC/ACB-330, 2005).

The subsections that follow highlight the statistical and observational conclusions of this technical note report.

5.1 Descriptive Statistics

The overall descriptive statistics for these error metrics are presented in Table 1 and distributions (histograms) are presented in Figure 6 through Figure 8. The average horizontal error was 0.85 nautical miles or about 5200 feet. The cross track error distribution is symmetrical about zero; however, the along track error distribution is strongly skewed in the negative direction. The radar position is consistently lagging in time. This bias in the data suggests that the Host radar data has an uncompensated delay. These results are very consistent with the previous companion report in reference (Ryan and Paglione, 2005).

For this study, the overall horizontal RMS is 0.97 nm while the companion study produced a value of 0.78 nm. The current simulation based study has slightly greater along track error and less than or equivalent cross track error. This can only be explained by the simulator's approximations due to its sampling process. Regardless, the results of both studies are very comparable.

5.2 Inferential Statistics

Although most of the statistical tests performed in Sections 4.2.1, 4.2.2, and 4.2.3 demonstrate a statistical significance, the actual differences appear to be below the level of accuracy of the data for altitude error and in many cases the cross track error. For horizontal and along track errors the differences range from 0.2 to 0.4 nautical miles depending on the factor being examined. These are modest impacts but do have some practical significance. Therefore, the altitude error and several of the tests for cross track error produce inferential tests that are rendered inconclusive. Nonetheless, these results do serve three very practical purposes. First, they do not rule out the possibility that there may be significant differences albeit not large enough to exceed the margin of error of this data accuracy. Second, they strengthen the case for the paired statistical test, used for two of the three analyses, since the results formally validated the normality assumption. In the event that the data distribution is not approximately normal, then there are statistical techniques to attempt to normalize the data. Third and possibly most importantly, they provide testing strategies and lessons for future data. The actual statistical methodology can be used as long as the lessons learned in this study carry over to future work.

An important lesson from this study is that the sample size used was too large as initially applied. Using an excessively large sample size produces an extra sensitive hypothesis test that detects effects smaller than the accuracy of the source data (Witte, 1993). In other words, the large sample size has increased the probability of rejecting a true null hypothesis, a Type I error. Of course using too small a sample size increases the probability of failing to reject a false null hypothesis, a Type II error.

The AMTWG can analyze the Power curves of the study results in order to determine a more appropriate sample size in the future. In the meantime, an estimate for the sample size from an approximately normal distribution of data can be roughly determined using the following equation from (Devore, 2000) and (Naiman et al., 1995):

$$a = \sqrt{\frac{(\sigma_1^2 + \sigma_2^2)(z_{\alpha/2} + z_{\beta})^2}{n}} \quad \text{Equation 1}$$

where n is the sample size of each sample being compared in this case assumed equal, σ_i^2 is the variance of the sample where i is the index of each sample, $z_{\alpha/2}$ and z_{β} are the standard normal statistics for a given significance level², and a is the accuracy of the desired confidence interval.

Using Equation 1 to estimate the accuracy of the statistical tests for the altitude error in this study when the sample size is in the thousands (e.g. as low as 21,267 for examining turns and 102,548 for the transitioning test), results in a level of accuracy less than 10 feet with confidence of 99%. Since the altitude source data is supplied in 100 feet increments, the reason for the inconclusive results becomes apparent.

For future studies using this methodology, an alternate use for Equation 1 is to assume a confidence interval of 100 feet (the resultant a in Equation 1), which again is based on the source data accuracy. Then the sample size for a 99% confidence interval is approximated at 200 and 250 observations for each of the tests referred to above, respectively. Of course a larger sample size can be used as long as the investigators bear in mind that the statistical tests may be more sensitive than the source data allows.

² At a 99% confidence, $z_{\alpha/2}$ is approximately 2.58 and z_{β} is 2.33. The α represents the accepted Type I error and β the accepted Type II error. At a 99% confidence, the Type I and Type II errors both equate to 0.01.

Therefore, the solution is future studies require more accurate source data and the sample size can be increased to match the accuracy. AMTWG determined two methods to improve this accuracy. First, AMTWG determined the turning and vertically transitioning state determination was based on the noisy HCS track reports. A simple way to improve the accuracy of the source data is to use the smoother GSGT positions to determine the phase of flight. Secondly, as illustrated in Section 4.2.1 and Appendix Section 8.3, pairing the data by comparing the sample mean of turning versus the same for not turning measurements will improve the accuracy of the inferential test and reduce the sample size. Both are desirable for this study and will be further explored by AMTWG in the future.

5.3 Illustrative Flight Samples

Three illustrative flight samples were documented in this study. The first sample flight segment represents an arrival flight of a large twin engine jet. It captures a series of interim altitudes issued by the controller during its descent to handoff to terminal control. A 360 degree turn occurs during the aircraft's descent and the maximum horizontal error goes to 1.4 nm. In both the descent and turn, the HCS tracker seems to over smooth the positions creating error as it does. It is assumed that the advanced tracker in ERAM could better handle the step climbs and large turn, making this flight example an excellent test case for the ERAM tracker.

Sample flight two represents a small Cessna aircraft, which is a small twin engine jet. Its flight includes a climb with a series of staircase like steps. It is speculated to be caused by ATC issuing interim altitude clearances as was verified by data reduction and analysis of the HCS CMS messages. Horizontally this aircraft flies a relatively straight path as it climbs to altitude. The errors are relatively low but can be mapped to the figures provided.

The third flight sample represents a straight forward cruising flight segment with typical errors, except a glitch appearing in the altitude positions. The glitch represents a 500 foot climb and 1000 foot descent and climb back to its cruising altitude, all in a five minute interval. AMTWG determined the glitch was present in the original field recording as well. Thus, GSGT simply recreated the same event in the simulation. This reveals the simulation approach is a true “SIM-from-SAR” capability. Namely, it is an empirical based simulation creating the same events present in the field recordings.

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³ Any of the WJHTC references are internal FAA documents and are accessible but must be requested from the FAA author of this technical note at mike.paglione@faa.gov.

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7 List of Acronyms

ACB-310	Separation Standards Analysis Group, WJHTC, FAA
ACB-330	Simulation and Analysis Group, WJHTC, FAA
ACB-550	ERAM & ECG Group, WJHTC, FAA
AMTWG	Automation Metrics Test Working Group
AOS-330	TMA Operational Support Group, WJHTC, FAA
ARINC	Aeronautical Radio, Inc.
ARTCC	Air Route Traffic Control Center
ASCII	American Standard Code for Information Exchange
ATC	Air Traffic Control
CID	Computer Identifier
CMS	Common Message Set
CPAT	Conflict Probe Assessment Team
ECG	En route Communications Gateway
ERAM	En Route Automation Modernization
FAA	Federal Aviation Administration
GPS	Global Positioning Satellite System
GPSS	Global Positioning Satellite System
HADDS	Host Air Traffic Management Data Distribution System
HCS	Host Computer System
Host	ARTCC main frame computer
JSA	Joseph Sheairs Associates, Inc.
RVSM	Reduced Vertical Separation Minima
SCN	ASCII radar data file format
SQL	Structured Query Language
TMA	Traffic Manager Advisor
WJHTC	William J. Hughes Technical Center
UTC	Universal Coordinated Time

8 Appendix

The following Appendices provide additional information to support the report.

8.1 Metric Definitions

The horizontal error is the distance in the stereographic horizontal plane between the GSGT track position and the radar track report having the same time. The horizontal error is split into two orthogonal components, the along track error and the cross track error. This split is illustrated in the following Figure 41.

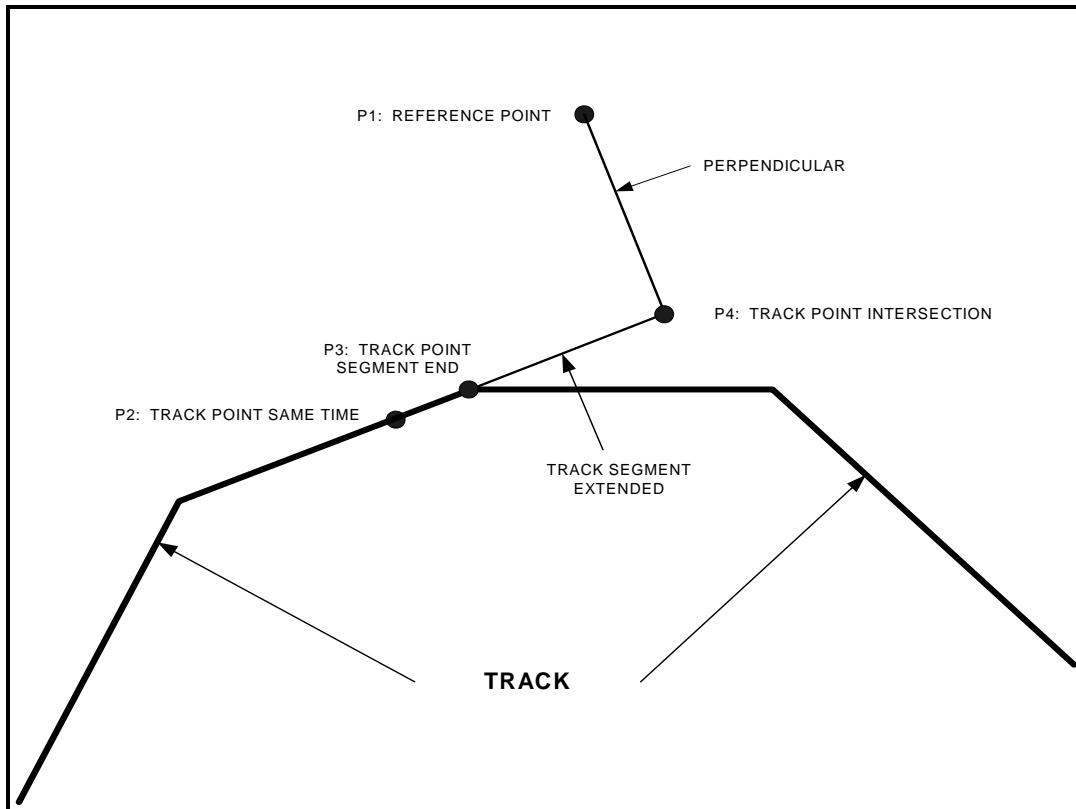


Figure 41: Aircraft Geometry for Measuring Along Track and Cross Track Errors

In the figure, the aircraft is flying from left to right. The GSGT reference track location is designated as P1. The radar track is a set of straight-line segments defined by the individual radar track reports - four are shown in the figure. The first step is to use interpolation to find the location on the track that has the same time as the GSGT reference point P1. This point is labeled P2. The horizontal error is defined as the straight-line distance between P1 and P2.

The next step in the calculation is to select the next track segment end point following P2, labeled as P3. A perpendicular is then drawn from the reference point P1 to the track segment P2-P3 or its line extension. In the figure, the perpendicular intersects the line P2-P3 extended to P4. The cross track or lateral error is defined as the length of the line P1-P4. The along track or longitudinal error is defined as the length of the line P2-P4.

If the reference point is to the right of the track, the cross track error is positive and otherwise is negative. If the reference point is ahead of the time synchronous track point, the along track error is positive and otherwise is negative. The sign (positive or negative) of the cross track error is the same as the sign of the vector cross product of the vectors from P2 to P1 and P2 to P3. The sign of the along track error is the same as the sign of the scalar product of the same vectors.

8.2 Descriptive Statistics per Flight

The following Table 10 provides a listing of the descriptive point statistics, including the mean and standard deviation, calculated per flight on the unsigned horizontal error and signed cross track, along track, and altitude errors. The call signs for the flights have been replaced with a sequential number concatenated by the HCS computer identification number.

Table 10: Descriptive Statistics for HCS Tracker Accuracy per Flight

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
1- 873	91	0.57764	0.227581	91	-0.09058	0.118531	91	-0.5522	0.241754	91	-181.42	248.24
2-446	258	1.41886	0.489673	258	-0.04254	0.125502	258	-1.4124	0.490598	258	10.08	63
3-546	357	0.99172	0.392119	357	-0.09003	0.133067	357	-0.9772	0.395708	357	38.66	153.4
4-508	349	0.58656	0.25888	349	0.03032	0.103942	349	-0.5696	0.273879	349	-28.5	73.06
5-706	83	0.92055	0.355953	83	0.07239	0.139338	83	-0.9059	0.359317	83	187.72	341.57
6- 826	263	1.34042	0.490803	263	-0.04892	0.114888	263	-1.3341	0.492295	263	43.59	165.04
7-586	410	0.9701	0.457391	410	-0.08464	0.132065	410	-0.9566	0.458938	410	72.52	247.05
8-714	385	0.57985	0.300481	385	0.05813	0.111824	385	-0.5628	0.306529	385	-41.63	107.57
9-523	154	1.43732	0.470653	154	-0.0201	0.123405	154	-1.4319	0.47055	154	124.62	275.49
10-430	171	1.08169	0.53423	171	-0.05006	0.149757	171	-1.0652	0.544075	171	95.22	252.53
11-714	159	1.14383	0.43151	159	-0.06409	0.130003	159	-1.1335	0.434541	159	24.82	117.11
12-191	38	0.42281	0.31297	38	-0.08438	0.080487	38	-0.3917	0.331912	38	-82.08	168.73
13-780	258	1.05923	0.430693	258	-0.03277	0.112706	258	-1.0498	0.437744	258	103.05	255.66
14-651	116	1.35848	0.437978	116	0.05379	0.105327	116	-1.3522	0.441591	116	0	0
15-464	2	1.51325	0.334674	2	0.1095	0.027719	2	-1.5093	0.333542	2	0	0
16-517	162	1.31547	0.461555	162	-0.01263	0.178227	162	-1.3012	0.467663	162	135.43	283.59
17-687	55	1.68776	0.346579	55	-0.01555	0.148583	55	-1.6799	0.353442	55	0	0
18-879	100	0.91744	0.461183	100	-0.05772	0.211653	100	-0.8113	0.591454	100	101.56	260.11
19-932	144	0.88793	0.31918	144	0.10924	0.203821	144	-0.8555	0.324417	144	92.97	218.06

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
20-349	339	1.17438	0.441074	339	-0.07913	0.114039	339	-1.1648	0.444659	339	0	0
21-047	280	1.00797	0.433016	280	-0.06926	0.165812	280	-0.9873	0.443411	280	-0.01	11.21
22-629	320	1.18204	0.458532	320	-0.07704	0.127051	320	-1.1714	0.461726	320	12.26	73.57
23-775	144	0.55903	0.30766	144	-0.04759	0.100234	144	-0.4955	0.386986	144	0	0
24-696	458	0.7395	0.278279	458	0.04275	0.128375	458	-0.7268	0.278958	458	-21.04	97.2
25-494	420	0.59083	0.275179	420	0.05868	0.126892	420	-0.5705	0.282606	420	0	0
26-835	304	1.20997	0.457915	304	-0.00953	0.121835	304	-1.1997	0.468632	304	16.87	93.54
27-512	176	0.60935	0.306796	176	-0.04058	0.169298	176	-0.5724	0.328141	176	-107.9	182.02
28-063	171	1.44628	0.51485	171	0.00195	0.151229	171	-1.4389	0.513301	171	127.56	278.89
29-110	501	0.63314	0.259657	501	0.0373	0.11985	501	-0.6178	0.26617	501	-30.32	127.15
30-618	79	1.75994	0.302949	79	-0.07026	0.157603	79	-1.7517	0.302203	79	105.08	229.72
31-637	283	0.68319	0.325521	283	0.0536	0.106114	283	-0.6697	0.331788	283	27.28	102.89
32-178	21	1.19808	0.419656	21	0.07999	0.211643	21	-1.1763	0.423022	21	0	0
33-292	68	0.82511	0.30193	68	0.04858	0.129417	68	-0.7981	0.341365	68	141.74	247.79
34-599	184	1.36589	0.481955	184	-0.01623	0.158793	184	-1.3572	0.480158	184	124.34	225.86
35-591	315	1.18328	0.599099	315	-0.02573	0.153938	315	-1.1668	0.611036	315	63.01	166.62
36-819	469	0.59548	0.251196	469	0.07525	0.120203	469	-0.575	0.258911	469	0	0
37-199	107	0.71207	0.29377	107	-0.04184	0.110042	107	-0.6827	0.337266	107	-89.46	208.07
38-257	223	0.62647	0.282022	223	-0.01304	0.11865	223	-0.6078	0.297335	223	-56.34	136.09
39-716	147	1.34313	0.464125	147	-0.01752	0.168839	147	-1.3325	0.463919	147	145.13	303.38
40-530	161	1.09554	0.483895	161	-0.02884	0.170521	161	-1.0708	0.508208	161	5.59	43.21
41-899	104	1.19579	0.384407	104	-0.08378	0.093369	104	-1.1888	0.385737	104	0	0
42-630	173	1.35394	0.489367	173	-0.00812	0.127439	173	-1.3481	0.488816	173	122.8	221.32
43-038	30	1.43376	0.351069	30	-0.08988	0.093112	30	-1.4267	0.356579	30	0	0
44-831	144	0.85803	0.358675	144	0.05536	0.136149	144	-0.8388	0.373926	144	-121.71	192.2
45-312	293	0.53483	0.293671	293	0.0097	0.110269	293	-0.516	0.306315	293	0	0
46-371	262	0.4427	0.250218	262	0.00335	0.105325	262	-0.4138	0.276264	262	0	0
47-123	251	1.15595	0.525864	251	-0.03798	0.125679	251	-1.1462	0.530781	251	72.72	201.14

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
48-264	153	1.41115	0.479107	153	-0.0254	0.162491	153	-1.4011	0.480545	153	149.2	299.9
49-680	168	0.61448	0.316462	168	0.00758	0.089993	168	-0.6007	0.329938	168	-139.92	233.5
50-106	54	0.60832	0.215986	54	-0.10275	0.092823	54	-0.5881	0.227992	54	-168.67	224.68
51-844	329	1.17023	0.501911	329	-0.03326	0.132776	329	-1.159	0.509431	329	80.93	248.55
52-446	213	1.08053	0.50136	213	0.00802	0.117673	213	-1.0726	0.504598	213	111.15	220.65
53-411	270	1.15037	0.526456	270	-0.04473	0.155009	270	-1.1359	0.533143	270	49.05	186.59
54-071	168	1.07531	0.426193	168	0.0318	0.146833	168	-1.0592	0.440073	168	120.74	208.34
55-898	255	0.60686	0.335408	255	-0.01787	0.099808	255	-0.538	0.425925	255	8.53	44.15
56-622	301	1.21958	0.467129	301	-0.00901	0.133789	301	-1.2112	0.469861	301	75.24	230.1
57-952	296	1.23193	0.472487	296	-0.02481	0.12705	296	-1.2234	0.476908	296	83.11	230.21
58-183	23	1.23716	0.387054	23	-0.0513	0.249599	23	-1.2126	0.384181	23	0	0
59-837	264	0.69293	0.35156	264	-0.02617	0.12138	264	-0.6685	0.376307	264	1.42	23.08
60-889	284	0.56667	0.29181	284	-0.00048	0.109718	284	-0.5519	0.299565	284	-8.55	64.87
61-572	279	0.50842	0.26377	279	-0.01909	0.122128	279	-0.4436	0.340896	279	0	0
62-710	150	1.30854	0.46386	150	-0.00412	0.158908	150	-1.2991	0.463199	150	181.3	316.88
63-527	356	1.13302	0.440101	356	-0.03843	0.125948	356	-1.1246	0.442049	356	82.52	209.71
64-961	97	1.21439	0.414484	97	0.04621	0.129227	97	-1.2057	0.417395	97	187.51	326.87
65-657	487	0.70302	0.29104	487	0.07174	0.115462	487	-0.6889	0.293199	487	-18.86	108.22
66-167	220	0.62054	0.350505	220	-0.01594	0.110901	220	-0.6007	0.366974	220	-58.7	135.71
67-623	311	1.12511	0.420643	311	-0.04646	0.135791	311	-1.1154	0.422174	311	53.41	185.53
68-956	501	0.62047	0.277582	501	0.0664	0.136498	501	-0.5995	0.282252	501	2.64	24.49
69-575	477	0.67408	0.312452	477	0.07615	0.118146	477	-0.6555	0.320334	477	-30.1	136.95
70-186	129	1.39755	0.379287	129	-0.0761	0.127296	129	-1.388	0.385541	129	0.58	17.53
71-941	349	1.13213	0.425171	349	-0.08233	0.124834	349	-1.1214	0.427345	349	-0.03	11.22
72-246	97	0.60377	0.164551	97	-0.0897	0.095167	97	-0.5891	0.165934	97	-95.48	171.82
73-500	136	1.55552	0.204457	136	-0.09481	0.137815	136	-1.5464	0.205754	136	18.13	111.32
74-385	207	1.04974	0.12999	207	0.07076	0.11805	207	-1.0408	0.129007	207	-10.96	75.22
75-045	154	1.47849	0.24886	154	-0.1018	0.126259	154	-1.469	0.252523	154	-0.01	9.46

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
76-954	207	1.06212	0.129728	207	0.08216	0.129386	207	-1.0511	0.129556	207	-0.36	11.68
77-168	270	1.12322	0.392216	270	-0.04407	0.113342	270	-1.1158	0.394501	270	0	0
78-107	205	1.01416	0.182341	205	0.08369	0.144642	205	-0.998	0.194582	205	-0.29	17.98
79-710	349	1.14001	0.447159	349	-0.05867	0.108565	349	-1.1318	0.451118	349	0	13.53
80-032	336	1.12874	0.406365	336	-0.07317	0.107732	336	-1.1209	0.407322	336	1.71	78.59
81-944	224	0.93468	0.223389	224	0.07474	0.14655	224	-0.9169	0.236467	224	0.13	17.4
82-936	199	1.13308	0.463677	199	-0.08889	0.108385	199	-1.1194	0.475652	199	1.65	18.98
83-768	156	1.52524	0.195405	156	-0.08569	0.153614	156	-1.5143	0.2017	156	1.12	23.39
84-520	336	1.03479	0.386069	336	-0.06402	0.105701	336	-1.0256	0.390812	336	0.61	11.9
85-251	43	1.16788	0.445805	43	-0.05407	0.256397	43	-1.0916	0.553579	43	-20.81	70.26
86-046	24	1.4794	0.054827	24	-0.09894	0.059298	24	-1.4749	0.056077	24	0	0
87-724	133	0.57656	0.22317	133	0.06731	0.100339	133	-0.5578	0.23795	133	70.76	151.07
88-013	159	0.45697	0.169957	159	-0.00401	0.130965	159	-0.4363	0.174121	159	-21.8	103.91
89-460	101	0.53024	0.197806	101	0.03583	0.125206	101	-0.4818	0.267713	101	31.29	89.74
90-404	296	1.22543	0.48592	296	-0.03478	0.140053	296	-1.215	0.490695	296	70.85	215.25
91-287	20	1.67576	0.126975	20	-0.0438	0.100321	20	-1.6724	0.126512	20	84.55	238.99
92-929	256	0.99978	0.366225	256	-0.05185	0.13	256	-0.9807	0.390501	256	9.2	109.4
93-729	140	0.44558	0.235918	140	0.00618	0.126769	140	-0.4266	0.237074	140	-34.11	109.64
94-850	345	0.59938	0.308575	345	0.0332	0.136112	345	-0.5779	0.317714	345	3.46	117.09
95-066	187	1.01102	0.358724	187	0.01577	0.133799	187	-1.0016	0.360028	187	46.49	380.61
96-060	250	0.68044	0.259807	250	-0.04533	0.122842	250	-0.667	0.261704	250	-35.44	222.79
97-614	179	0.90587	0.32828	179	0.05222	0.121192	179	-0.8936	0.335425	179	79.36	371.9
98-149	26	0.41585	0.255742	26	-0.04411	0.107224	26	-0.3193	0.354516	26	-188	264.18
99-704	55	0.61518	0.189325	55	0.01836	0.161369	55	-0.5933	0.190661	55	-199.25	320.69
100-028	125	0.98666	0.421545	125	-0.12122	0.122438	125	-0.972	0.420429	125	59.75	270.53
101-290	274	1.13643	0.511451	274	-0.03731	0.171047	274	-1.1196	0.518722	274	66.51	189.32
102-840	184	0.98432	0.357815	184	0.02742	0.12824	184	-0.9748	0.359859	184	87.29	285.06
103-359	194	0.99848	0.356999	194	0.0401	0.151852	194	-0.9839	0.363196	194	81.81	266.46

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
104-675	133	0.75501	0.301722	133	0.05406	0.128636	133	-0.7379	0.311822	133	70.02	188.86
105-865	102	0.58765	0.321078	102	0.00831	0.10434	102	-0.5597	0.352817	102	-82.25	199.74
106-987	145	1.42372	0.137643	145	-0.11753	0.151147	145	-1.4111	0.134786	145	-30.95	131.32
107-734	204	1.15936	0.424303	204	-0.0017	0.145332	204	-1.1473	0.432153	204	66.32	215.93
108-559	135	0.716	0.320306	135	0.04204	0.107602	135	-0.7044	0.325287	135	49.72	171.94
109-175	94	1.09499	0.352354	94	0.02389	0.148543	94	-1.0817	0.36147	94	191.26	270.34
110-923	106	1.12138	0.364344	106	0.02814	0.131287	106	-1.1126	0.366772	106	132.61	248.95
111-453	162	1.25443	0.421535	162	0.04124	0.223444	162	-1.2334	0.422875	162	157.77	296.21
112-313	122	0.61468	0.295335	122	-0.01283	0.096876	122	-0.5928	0.322945	122	-129.93	287.39
113-577	256	0.88575	0.402291	256	-0.01524	0.146321	256	-0.8667	0.416811	256	15.71	215.73
114-580	225	0.92051	0.334493	225	-0.03889	0.159871	225	-0.9049	0.33688	225	59.26	251.47
115-390	105	1.06236	0.357148	105	0.01858	0.124899	105	-1.0552	0.356127	105	146.8	287.32
116-059	105	0.46785	0.162174	105	-0.04471	0.13159	105	-0.4433	0.171839	105	-115.13	202.21
117-282	156	1.1867	0.604072	156	-0.058	0.134234	156	-1.1727	0.613891	156	127.81	286.47
118-114	30	1.04111	0.450602	30	0.06381	0.133694	30	-1.0013	0.51481	30	0	0
119-975	215	0.90468	0.404782	215	-0.01803	0.134987	215	-0.8917	0.41084	215	52.88	199.53
120-808	150	1.40569	0.487833	150	0.00156	0.212056	150	-1.3871	0.495338	150	148.77	282.22
121-118	128	0.6524	0.340221	128	-0.04236	0.083263	128	-0.6379	0.354858	128	-56.66	158.29
122-476	72	0.75029	0.267357	72	-0.04899	0.077364	72	-0.733	0.298494	72	-253.67	272.46
123-735	158	1.25603	0.425889	158	-0.02258	0.142378	158	-1.2474	0.426932	158	200.92	349.4
124-074	149	1.44994	0.465169	149	-0.01902	0.193506	149	-1.436	0.468042	149	158.22	317.2
125-625	88	0.64642	0.217483	88	-0.10988	0.129854	88	-0.6222	0.222022	88	-209.56	239.53
126-480	108	0.83218	0.24351	108	0.04655	0.116662	108	-0.8203	0.251553	108	59.54	200.89
127-683	126	1.29192	0.4851	126	0.02766	0.216124	126	-1.2609	0.517267	126	181.44	354.14
128-084	144	1.27509	0.415984	144	-0.00962	0.169502	144	-1.263	0.418549	144	198.24	333.94
129-571	113	0.94409	0.405513	113	-0.00775	0.167068	113	-0.9259	0.413207	113	160.32	300.93
130-581	189	1.01719	0.501791	189	-0.07581	0.123214	189	-1.0036	0.508451	189	70.2	246.93
131-778	245	0.93033	0.410522	245	-0.02779	0.14059	245	-0.9165	0.416613	245	56.42	198.46

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
132-734	216	0.60056	0.290784	216	0.06944	0.118787	216	-0.5798	0.300358	216	-35.78	199.67
133-950	181	0.82135	0.371059	181	-0.02749	0.128267	181	-0.8073	0.378803	181	24.87	166.56
134-023	239	0.71492	0.418796	239	-0.00207	0.182633	239	-0.6658	0.458397	239	-16.85	142.62
135-670	150	1.2231	0.399944	150	0.00277	0.166122	150	-1.2092	0.407816	150	149.07	274.38
136-387	220	1.0133	0.454674	220	-0.00705	0.133092	220	-1.0011	0.462244	220	74.3	214.57
137-366	129	1.37248	0.206762	129	-0.00009	0.149409	129	-1.3643	0.207184	129	132.66	250.41
138-627	159	1.29733	0.396205	159	0.04924	0.164219	159	-1.2816	0.410409	159	134.44	225.9
139-813	237	1.04035	0.449793	237	-0.01141	0.129803	237	-1.0276	0.460244	237	58	189.11
140-525	83	0.61668	0.114841	83	-0.07596	0.112624	83	-0.6012	0.117452	83	-133.58	194.97
141-676	179	0.86861	0.393156	179	-0.01048	0.127251	179	-0.8569	0.398211	179	-62.08	181.31
142-822	203	0.78569	0.333268	203	-0.01022	0.143659	203	-0.7714	0.33574	203	14.67	175.49
143-223	168	0.877786	0.414821	168	-0.03072	0.139487	168	-0.8573	0.432971	168	-78.76	167.34
144-157	101	0.57639	0.296712	101	-0.08318	0.147411	101	-0.5392	0.318187	101	-123.29	193.66
145-333	42	0.5283	0.191525	42	-0.08023	0.070549	42	-0.5139	0.201156	42	-134.36	211.52
146-440	168	1.17414	0.5516	168	-0.0587	0.158347	168	-1.157	0.562168	168	78.19	199.22
147-839	206	0.78855	0.355235	206	-0.01643	0.168719	206	-0.7638	0.368817	206	51.63	237.24
148-212	290	0.8196	0.351487	290	-0.02657	0.139049	290	-0.8032	0.36088	290	30.84	189.8
149-043	50	0.29544	0.156887	50	0.07083	0.147191	50	-0.2057	0.209087	50	-115.68	179.27
150-589	147	1.12733	0.380701	147	0.01608	0.15028	147	-1.1143	0.389155	147	150.1	294.84
151-103	240	1.08418	0.380631	240	0.03972	0.149481	240	-1.0726	0.382196	240	68.92	163.51
152-120	5	0.17448	0.060886	5	0.09798	0.065106	5	-0.0687	0.14008	5	0	0
153-749	349	0.62213	0.253282	349	0.03409	0.124078	349	-0.6038	0.264762	349	-10.03	70.23
154-643	172	0.72142	0.307975	172	-0.01179	0.164105	172	-0.6997	0.31439	172	30.03	130.27
155-735	114	0.86211	0.37569	114	0.00302	0.189161	114	-0.8354	0.38874	114	123.87	247.54
156-610	489	0.70246	0.295803	489	0.0799	0.117879	489	-0.6847	0.303039	489	-1.74	17.07
157-823	320	0.65549	0.292836	320	0.01904	0.135976	320	-0.6351	0.305407	320	0	0
158-747	176	1.04496	0.4286	176	0.04698	0.182624	176	-1.0202	0.446589	176	99.85	225.86
159-351	197	0.721	0.354436	197	-0.01827	0.111098	197	-0.705	0.368665	197	17.87	195.57

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
160-509	125	0.5936	0.34398	125	-0.03285	0.111894	125	-0.5703	0.363412	125	0	0
161-128	416	0.64278	0.262732	416	0.039	0.120295	416	-0.6275	0.269163	416	-35.96	135.12
162-906	86	0.59453	0.21296	86	-0.04675	0.127762	86	-0.576	0.220734	86	-103.7	150.6
163-911	451	0.50892	0.311219	451	0.05847	0.125209	451	-0.4863	0.316675	451	60.92	206.86
164-411	286	1.01521	0.394495	286	-0.05957	0.125224	286	-1.0038	0.399391	286	-16.93	271.62
165-415	131	0.45815	0.197533	131	-0.05188	0.126664	131	-0.4311	0.210951	131	-51.95	115.31
166-528	260	0.98804	0.360791	260	0.05912	0.126012	260	-0.9769	0.36428	260	72.67	198.47
167-926	240	0.56844	0.310961	240	-0.00726	0.106096	240	-0.5376	0.345836	240	5.83	49.03
168-022	93	0.6149	0.202513	93	-0.05156	0.137914	93	-0.5949	0.209235	93	-79.61	158.41
169-725	168	0.67881	0.261028	168	-0.02342	0.130373	168	-0.6612	0.272526	168	-2.71	200.18
170-919	332	1.12595	0.435559	332	-0.02044	0.106518	332	-1.1196	0.438501	332	69.42	211.13
171-635	226	0.67567	0.356796	226	-0.00527	0.108302	226	-0.6581	0.373031	226	0	0
172-668	249	0.64995	0.331322	249	-0.00661	0.122033	249	-0.6348	0.338211	249	12.58	71.77
173-759	303	1.21432	0.499081	303	-0.04069	0.142874	303	-1.2039	0.502255	303	79.82	210.64
174-053	378	0.62001	0.290171	378	0.03366	0.11818	378	-0.6019	0.302098	378	-48.21	156.32
175-485	493	0.64414	0.256634	493	0.04924	0.115727	493	-0.6288	0.263883	493	-30.82	121.92
176-861	292	1.16879	0.509204	292	-0.02289	0.126493	292	-1.1606	0.511821	292	79.52	217.75
177-428	181	1.14343	0.524531	181	0.04073	0.197746	181	-1.1264	0.522748	181	173.4	298.77
178-416	151	1.24978	0.344841	151	0.01872	0.1283	151	-1.2425	0.346795	151	180.25	307.49
179-907	124	0.89418	0.23096	124	0.02608	0.111289	124	-0.8863	0.233264	124	90.65	232.12
180-187	174	0.4357	0.234453	174	-0.01315	0.124901	174	-0.4126	0.242642	174	-14.71	92.9
181-743	195	0.88857	0.325122	195	0.03674	0.112145	195	-0.8807	0.325251	195	68.57	210.44
182-794	290	0.71272	0.278218	290	-0.05982	0.110044	290	-0.7015	0.278595	290	3.02	174.18
183-921	115	0.6071	0.274178	115	-0.07523	0.112438	115	-0.5905	0.277275	115	-96.09	185.44
184-053	365	1.05715	0.458581	365	-0.01573	0.127622	365	-1.0476	0.462509	365	56.94	181.21
185-914	90	0.98205	0.342226	90	0.06493	0.126072	90	-0.97	0.347428	90	-170.98	281.92
186-817	257	0.66762	0.332224	257	0.00876	0.149912	257	-0.5987	0.418835	257	0	0
187-326	166	0.7801	0.343429	166	-0.04042	0.103239	166	-0.7679	0.352996	166	61.41	256.02

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
188-255	397	1.10459	0.434263	397	-0.00224	0.16774	397	-1.0849	0.451279	397	66.48	204.11
189-606	233	0.67767	0.350927	233	0.06429	0.127265	233	-0.6589	0.357764	233	24	201.37
190-274	220	0.69992	0.366375	220	0.06638	0.128877	220	-0.68	0.375173	220	44.93	170.43
191-173	164	0.34503	0.20718	164	-0.03768	0.118749	164	-0.2863	0.254365	164	-7.32	62.48
192-947	256	1.20783	0.495834	256	-0.03765	0.093939	256	-1.2019	0.499829	256	85.3	274.47
193-712	65	0.43329	0.220651	65	0.0657	0.127044	65	-0.398	0.240786	65	-44.26	125.17
194-338	133	0.90948	0.302055	133	0.05943	0.126701	133	-0.896	0.3102	133	-19.57	93.66
195-813	260	1.2349	0.44906	260	-0.04782	0.175732	260	-1.2208	0.450804	260	62.97	218.82
196-661	336	1.01257	0.427319	336	-0.02056	0.129942	336	-1.0033	0.429064	336	50.89	215.36
197-186	376	0.66339	0.311154	376	0.06411	0.138218	376	-0.6433	0.316184	376	28.86	141.17
198-746	368	0.60522	0.301839	368	0.06181	0.124379	368	-0.5869	0.306089	368	28.02	131.01
199-609	349	0.71456	0.319665	349	0.01486	0.133617	349	-0.7013	0.320923	349	31.93	139.62
200-736	130	0.83423	0.401675	130	-0.02409	0.124238	130	-0.8225	0.406062	130	168.47	194.09
201-090	100	1.14102	0.557903	100	-0.05041	0.127097	100	-1.1294	0.564925	100	160.45	320.43
202-894	416	0.62062	0.285703	416	0.03859	0.123475	416	-0.6035	0.293169	416	-5.9	55.03
203-493	73	1.21784	0.536995	73	-0.07419	0.198384	73	-0.9456	0.91689	73	274.28	410.4
204-294	189	1.15656	0.425177	189	0.03093	0.164888	189	-1.1421	0.431256	189	136.78	318.96
205-908	457	0.57314	0.267693	457	0.04037	0.130181	457	-0.5518	0.277833	457	0	0
206-049	359	0.61594	0.280615	359	0.00959	0.127358	359	-0.5983	0.289659	359	0	3.1
207-134	232	1.23933	0.482976	232	-0.05195	0.142151	232	-1.2226	0.501693	232	44.96	166.73
208-797	125	0.55004	0.285109	125	-0.0468	0.13812	125	-0.4745	0.371495	125	0	0
209-195	30	0.65478	0.179813	30	0.02652	0.099033	30	-0.6453	0.186033	30	-52.5	124.8
210-594	195	1.2501	0.527253	195	-0.00567	0.146765	195	-1.2359	0.540173	195	97.71	210.74
211-566	66	0.97346	0.124916	66	0.15492	0.129778	66	-0.953	0.119913	66	-251.58	347.34
212-483	85	1.45624	0.47794	85	-0.10634	0.146613	85	-1.4413	0.489282	85	0	0
213-204	166	1.31101	0.489944	166	-0.00712	0.170625	166	-1.2963	0.499436	166	118.64	260.07
214-288	210	1.05393	0.470861	210	0.03588	0.153621	210	-1.0384	0.47899	210	96.4	193.24
215-559	44	1.46145	0.518229	44	-0.03564	0.131556	44	-1.4524	0.526158	44	0	0

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
216-864	69	0.63006	0.348567	69	-0.03353	0.095957	69	-0.6195	0.352809	69	-225.96	307.14
217-832	153	0.42325	0.125619	153	-0.02271	0.138618	153	-0.3911	0.149762	153	18.55	97.11
218-628	149	1.35476	0.384557	149	0.00386	0.097003	149	-1.3511	0.38508	149	-27.21	105.65
219-584	337	0.41503	0.234007	337	0.05725	0.115056	337	-0.3848	0.249928	337	9.73	128.8
220-336	123	0.51918	0.171945	123	0.05331	0.116914	123	-0.4998	0.18153	123	-155.24	219.85
221-008	166	1.08042	0.346867	166	0.03762	0.115248	166	-1.0734	0.347621	166	51.68	164.92
222-044	188	0.56158	0.294363	188	0.00785	0.112708	188	-0.5469	0.300411	188	0.66	9.12
223-753	391	0.89644	0.413974	391	-0.04053	0.110847	391	-0.8873	0.416906	391	6.19	195.9
224-111	445	0.70274	0.30905	445	0.07665	0.110879	445	-0.6879	0.313133	445	48.02	209.49
225-943	156	0.88519	0.387579	156	-0.03326	0.129959	156	-0.8717	0.394962	156	-78.1	171.55
226-658	273	1.07724	0.356846	273	-0.06405	0.160789	273	-1.0626	0.358912	273	-26.96	287.39
227-604	250	0.57647	0.301971	250	-0.01436	0.097219	250	-0.5403	0.349457	250	0	0
228-031	321	1.1144	0.466956	321	-0.05123	0.121483	321	-1.1046	0.471555	321	53.33	214.58
229-133	114	0.59342	0.240646	114	-0.07046	0.124314	114	-0.5649	0.266151	114	-89.39	177.34
230-050	354	0.62474	0.34245	354	0.05895	0.147521	354	-0.6021	0.346195	354	57.83	214.89
231-082	315	0.53799	0.241622	315	0.04897	0.118441	315	-0.5195	0.248009	315	-29.5	113.65
232-950	211	0.67211	0.309508	211	0.03619	0.113378	211	-0.6602	0.312318	211	-12.75	54.15
233-912	199	0.70297	0.362593	199	-0.02131	0.095271	199	-0.6932	0.368238	199	-39.35	145.7
234-011	251	0.50384	0.273423	251	-0.00303	0.089011	251	-0.49	0.283919	251	-8.84	49.23
235-347	333	0.60567	0.350293	333	0.06804	0.15115	333	-0.5746	0.363266	333	45.18	254.22
236-064	140	1.29157	0.421389	140	-0.00659	0.12716	140	-1.2848	0.422868	140	190.55	306.53
237-099	145	0.58322	0.295249	145	-0.00536	0.08026	145	-0.5752	0.300063	145	-135.79	239.59
238-493	162	1.33462	0.399878	162	-0.02713	0.156647	162	-1.3255	0.398933	162	158.46	304.68
239-906	211	1.16178	0.411271	211	0.01579	0.130601	211	-1.153	0.415078	211	95.95	205.84
240-974	78	0.93561	0.326898	78	0.03332	0.143506	78	-0.9235	0.328714	78	197.05	348.61
241-087	83	0.80727	0.31248	83	0.06337	0.133912	83	-0.7925	0.315449	83	186.81	285.28
242-874	152	0.61962	0.236553	152	-0.00165	0.123346	152	-0.605	0.242382	152	-125.16	274.11
243-131	109	0.81301	0.355429	109	0.00137	0.189805	109	-0.7913	0.354176	109	100.48	203.68

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
244-043	185	1.13986	0.53005	185	-0.04843	0.118853	185	-1.1287	0.538525	185	109.86	235.03
245-102	106	1.09171	0.378697	106	0.03299	0.126287	106	-1.083	0.38146	106	185.46	299.01
246-276	203	1.1686	0.465616	203	0.01919	0.127007	203	-1.1607	0.467868	203	90.94	182.63
247-520	65	0.5597	0.257844	65	0.04666	0.142426	65	-0.5245	0.287687	65	-77.68	156.62
248-970	98	0.93991	0.325671	98	0.04744	0.144538	98	-0.926	0.330325	98	98.78	226.48
249-248	203	0.83598	0.378676	203	-0.10167	0.128876	203	-0.8137	0.391511	203	-22.18	328
250-518	198	0.68363	0.296571	198	-0.01194	0.115116	198	-0.6704	0.304232	198	-66.52	208.19
251-842	142	1.31712	0.463116	142	-0.0087	0.156407	142	-1.3059	0.468458	142	176.03	290.82
252-829	260	0.5364	0.300427	260	-0.04275	0.089392	260	-0.5198	0.313078	260	5.18	79.03
253-432	218	0.5801	0.149816	218	-0.02216	0.136959	218	-0.5603	0.16104	218	-30.17	94.2
254-645	281	0.49409	0.221002	281	0.08716	0.133152	281	-0.4627	0.231621	281	15.24	90.9
255-767	266	0.4253	0.161304	266	-0.04994	0.109064	266	-0.4013	0.177673	266	-17.75	63.55
256-565	191	0.38858	0.138014	191	0.04778	0.183909	191	-0.3387	0.139341	191	35.27	94.67
257-809	126	0.75107	0.186051	126	0.02165	0.15085	126	-0.7337	0.193537	126	98.98	128.62
258-576	32	0.50663	0.21828	32	-0.01789	0.166353	32	-0.4645	0.248773	32	-82.41	126.8
259-408	299	1.19918	0.500542	299	-0.07002	0.139423	299	-1.1872	0.504837	299	75.2	215.12
260-417	302	0.64124	0.29419	302	0.03891	0.146144	302	-0.6045	0.330988	302	-49.15	128.25
261-106	251	0.70933	0.302319	251	0.04665	0.108123	251	-0.6964	0.309436	251	-59	182.63
262-418	281	0.3761	0.130213	281	0.01005	0.13159	281	-0.3184	0.199406	281	-6.18	40.96
263-258	210	1.20976	0.453001	210	-0.04352	0.125036	210	-1.201	0.457105	210	29.32	121.57
264-646	288	1.1629	0.496521	288	-0.03723	0.115014	288	-1.1513	0.508761	288	106.16	254.63
265-771	354	0.66857	0.28387	354	0.04073	0.150154	354	-0.6489	0.287079	354	0	0
266-828	374	0.64017	0.289319	374	0.03091	0.121619	374	-0.6244	0.296558	374	-2.65	34.97
267-430	256	1.04451	0.488618	256	-0.06552	0.148711	256	-1.0291	0.494433	256	69.86	213.42
268-030	282	0.58729	0.320508	282	-0.00404	0.11683	282	-0.5714	0.327975	282	-0.42	12.22
269-222	354	0.62677	0.281024	354	0.01409	0.134342	354	-0.6071	0.291638	354	0	0
270-428	341	1.23007	0.54443	341	-0.01882	0.100407	341	-1.2239	0.548611	341	61.55	212.51
271-746	332	1.19074	0.455805	332	-0.01574	0.116871	332	-1.1833	0.459962	332	71.35	207.48

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
272-729	94	0.48424	0.114164	94	-0.08918	0.102737	94	-0.4629	0.122098	94	-56.03	186.27
273-896	266	0.71109	0.291319	266	0.01265	0.139448	266	-0.6776	0.334609	266	-48.57	136.87
274-002	327	1.19727	0.493438	327	-0.0257	0.110157	327	-1.1907	0.496447	327	60.23	195.74
275-181	310	0.64112	0.281708	310	0.02283	0.128528	310	-0.6266	0.284286	310	-15.83	79.55
276-098	343	1.14928	0.459851	343	-0.03278	0.168409	343	-1.1347	0.464123	343	63.98	173.95
277-105	279	1.33217	0.461734	279	-0.04845	0.136507	279	-1.3238	0.463206	279	39.31	153.3
278-408	395	0.60702	0.298648	395	0.05363	0.12021	395	-0.5905	0.302722	395	-1.63	32.3
279-039	341	1.13998	0.456698	341	-0.02421	0.111505	341	-1.1324	0.461343	341	66.79	240.72
280-708	358	1.09612	0.469757	358	-0.0285	0.153231	358	-1.078	0.485598	358	67.03	170.35
281-938	104	0.76059	0.272185	104	0.09031	0.095962	104	-0.7459	0.281103	104	-83.76	143.62
282-585	75	0.83377	0.302109	75	0.04009	0.11685	75	-0.8243	0.303197	75	148.77	212.22
283-996	240	0.77187	0.347814	240	0.06363	0.104805	240	-0.7557	0.361491	240	-52.1	190.16
284-576	362	1.12053	0.416312	362	-0.05306	0.096214	362	-1.1137	0.420164	362	68.67	207.84
285-427	30	1.41381	0.352137	30	-0.12675	0.087393	30	-1.4046	0.355942	30	0	0
286-236	501	0.64122	0.271951	501	0.07998	0.111321	501	-0.6252	0.274663	501	-28.37	116.75
287-595	345	1.21436	0.468096	345	-0.01957	0.121577	345	-1.2072	0.470373	345	68.44	185.7
288-330	359	1.13328	0.422276	359	-0.02987	0.115885	359	-1.1259	0.42522	359	69.96	196.69
289-406	174	1.42444	0.492193	174	-0.00969	0.138574	174	-1.4176	0.492441	174	116.53	260.08
290-929	317	0.60353	0.294152	317	-0.00466	0.109695	317	-0.58	0.319971	317	-0.51	76.56
291-699	423	0.79088	0.375969	423	0.07451	0.097453	423	-0.7773	0.384335	423	-15.12	83.89
292-591	91	1.24703	0.406077	91	0.03008	0.120487	91	-1.2389	0.412081	91	0	0
293-835	183	1.27216	0.50867	183	-0.03493	0.123377	183	-1.2648	0.510838	183	93.26	252.01
294-009	156	1.32465	0.492045	156	-0.02432	0.181025	156	-1.3067	0.506117	156	167	275.32
295-881	259	0.51515	0.25947	259	0.05882	0.116058	259	-0.4946	0.266883	259	0	0
296-568	336	1.22022	0.43951	336	-0.0501	0.108339	336	-1.2134	0.442218	336	70.32	215.9
297-016	119	0.81802	0.271473	119	0.02165	0.128357	119	-0.8058	0.277073	119	80.39	199.52
298-357	191	1.13496	0.526968	191	-0.06625	0.123234	191	-1.1224	0.535426	191	109.69	235.53
299-333	322	1.22482	0.491121	322	-0.01522	0.100332	322	-1.2192	0.494637	322	51.32	191.64

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
300-672	268	1.34476	0.473554	268	-0.02929	0.108649	268	-1.3394	0.47545	268	22.4	95.65
301-984	315	1.21371	0.465664	315	-0.00283	0.099765	315	-1.2086	0.468322	315	73.87	194.5
302-182	484	0.68508	0.285789	484	0.04293	0.127474	484	-0.6687	0.292812	484	-23.38	93.03
303-310	465	0.75854	0.270906	465	0.03576	0.116802	465	-0.7469	0.275673	465	-15.4	93.41
304-030	130	1.13994	0.349673	130	0.01995	0.150545	130	-1.1268	0.359444	130	128.04	241.9
305-350	201	1.09131	0.532056	201	-0.04082	0.139843	201	-1.0797	0.535941	201	114.39	200.59
306-374	270	1.31598	0.461767	270	-0.02827	0.160536	270	-1.3039	0.467223	270	76.41	214.05
307-578	288	1.19247	0.490892	288	-0.03862	0.11515	288	-1.182	0.501113	288	96.32	249.3
308-358	300	0.65491	0.356086	300	0.01158	0.118191	300	-0.6241	0.390106	300	3.92	46.93
309-621	340	0.71157	0.337405	340	0.01933	0.135509	340	-0.6909	0.352475	340	10.24	94.2
310-507	311	1.14163	0.470838	311	-0.0191	0.130982	311	-1.1332	0.472669	311	49.2	182.91
311-681	83	0.55985	0.299105	83	-0.03603	0.155476	83	-0.4774	0.387998	83	0	0
312-777	466	0.69035	0.297963	466	0.05942	0.120723	466	-0.6734	0.306355	466	-10.45	54.91
313-903	182	0.75866	0.357015	182	-0.04872	0.109395	182	-0.7432	0.369326	182	21.53	211.96
314-742	389	1.04932	0.42415	389	-0.04109	0.10515	389	-1.0412	0.429267	389	58.5	174.36
315-419	387	1.04022	0.422026	387	-0.04642	0.125615	387	-1.0293	0.4277	387	35.87	134.96
316-433	153	0.77888	0.31429	153	0.00238	0.149406	153	-0.7634	0.316941	153	-89.61	274.81
317-808	223	0.65782	0.307872	223	0.01698	0.122267	223	-0.6229	0.352783	223	-14.06	71.91
318-980	151	0.85188	0.433452	151	-0.03065	0.128911	151	-0.8356	0.444891	151	-51.19	125.18
319-083	294	1.16566	0.422781	294	-0.00632	0.177108	294	-1.1458	0.439888	294	9.47	231.6
320-931	434	0.74316	0.349946	434	0.02882	0.130665	434	-0.7285	0.355139	434	-14.03	88.11
321-654	348	0.8087	0.32543	348	-0.04243	0.150778	348	-0.792	0.328964	348	-31.14	191.26
322-751	140	1.54094	0.397806	140	-0.00975	0.132659	140	-1.5357	0.396021	140	0	0
323-804	466	0.71562	0.320994	466	0.03827	0.115444	466	-0.7004	0.331382	466	-18.21	95.05
324-815	131	1.1579	0.400629	131	0.01991	0.112528	131	-1.1511	0.404085	131	53.88	269.35
325-346	207	0.80499	0.395733	207	-0.01023	0.110089	207	-0.7919	0.406718	207	-11.43	96.41
326-580	38	0.65391	0.180552	38	0.0016	0.058843	38	-0.6511	0.181469	38	-305.42	369.7
327-925	263	0.56742	0.31962	263	0.0097	0.112165	263	-0.5497	0.330605	263	-2.22	25.92

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
328-534	479	0.74149	0.314287	479	0.05372	0.118168	479	-0.7273	0.320666	479	-20.53	119.63
329-532	324	1.11026	0.436287	324	-0.02912	0.106061	324	-1.1033	0.440039	324	37.64	201.8
330-403	109	0.75188	0.394717	109	0.00178	0.14186	109	-0.7274	0.414915	109	-31.26	97.68
331-731	161	1.22193	0.389657	161	-0.01453	0.153593	161	-1.2116	0.391486	161	139.34	247.85
332-244	273	1.11061	0.445116	273	-0.04421	0.130776	273	-1.0965	0.458612	273	90.56	225.93
333-468	157	0.95942	0.310915	157	0.02321	0.098454	157	-0.9542	0.310677	157	82.19	218.57
334-669	266	0.70305	0.258528	266	-0.04472	0.135093	266	-0.6875	0.261316	266	-6.85	195.04
335-023	108	1.02694	0.397289	108	0.03058	0.102397	108	-1.0219	0.395893	108	75.65	170.46
336-286	347	1.06005	0.495015	347	-0.03088	0.173614	347	-1.0413	0.503396	347	18.55	219.38
337-737	316	1.17877	0.423631	316	-0.05612	0.118885	316	-1.1695	0.428816	316	26.29	184.56
338-047	318	1.17256	0.477137	318	-0.01404	0.142862	318	-1.1575	0.492168	318	41.54	166.02
339-991	163	1.538	0.400546	163	-0.05782	0.13982	163	-1.5299	0.403063	163	0	0
340-309	385	0.57115	0.266193	385	0.03669	0.104223	385	-0.5541	0.279064	385	-27.47	100.06
341-860	95	0.53314	0.202173	95	-0.07314	0.104459	95	-0.5164	0.205717	95	-174.73	283.66
342-755	207	0.78104	0.330509	207	-0.1008	0.112583	207	-0.7636	0.336823	207	-12.37	195.47
343-945	363	0.54679	0.289778	363	0.05086	0.116978	363	-0.5293	0.294181	363	-0.49	26.23
344-727	259	1.01087	0.380822	259	-0.02155	0.144081	259	-0.9983	0.38618	259	-41.55	164.48
345-449	202	1.13632	0.423803	202	0.04901	0.14296	202	-1.1253	0.426454	202	78.64	191.09
346-358	171	1.14998	0.434122	171	0.03083	0.163256	171	-1.133	0.447155	171	68.87	199.56
347-554	377	0.67104	0.331452	377	0.0383	0.13408	377	-0.6294	0.380356	377	15.04	72.25
348-156	131	0.66697	0.266198	131	0.01793	0.158607	131	-0.6454	0.271968	131	-87.08	194.41
349-360	78	0.77707	0.340399	78	0.06311	0.117267	78	-0.7633	0.345704	78	170.06	227.47
350-117	60	0.70023	0.330712	60	0.07312	0.118042	60	-0.6853	0.333108	60	-113.35	164.09
351-172	311	1.09614	0.394181	311	-0.06242	0.11531	311	-1.0879	0.395244	311	1.59	25.32
352-620	207	1.0932	0.418444	207	0.05943	0.129248	207	-1.0811	0.425769	207	72.83	189.45
353-852	315	1.08374	0.437742	315	-0.01432	0.125136	315	-1.0749	0.441407	315	48.44	216.54
354-584	72	0.56101	0.395736	72	-0.01487	0.133476	72	-0.5331	0.411798	72	0	0
355-844	192	0.59659	0.301452	192	0.08816	0.121618	192	-0.5738	0.308401	192	38.25	174.03

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
356-719	297	1.01813	0.479237	297	-0.0584	0.167849	297	-0.9944	0.496031	297	-4.64	272.65
357-010	111	0.82681	0.356513	111	-0.00302	0.108453	111	-0.8125	0.37282	111	195.05	314.31
358-606	113	0.70636	0.32564	113	-0.02583	0.094417	113	-0.6982	0.328723	113	-108.08	257.71
359-516	130	1.05573	0.354431	130	0.00213	0.138763	130	-1.0471	0.353153	130	95.5	224.76
360-593	175	0.52933	0.293032	175	0.02132	0.14105	175	-0.4903	0.324805	175	0.33	4.38
361-534	251	0.68805	0.360237	251	0.01491	0.140789	251	-0.6599	0.38444	251	8.63	54.49
362-593	146	1.24499	0.40196	146	-0.00209	0.134895	146	-1.2368	0.404871	146	132.68	271.56
363-796	32	1.26988	0.388807	32	0.06302	0.122487	32	-1.261	0.393944	32	0	0
364-472	336	0.9799	0.366109	336	-0.02247	0.134037	336	-0.9634	0.384428	336	25.44	146.73
365-253	314	1.36084	0.464044	314	-0.04094	0.136187	314	-1.3523	0.467326	314	41.75	161.38
366-523	152	0.88427	0.376912	152	-0.08481	0.162124	152	-0.8616	0.385165	152	-18.53	234.41
367-551	89	1.15359	0.232294	89	-0.04187	0.167276	89	-1.1392	0.239898	89	200.03	336.26
368-064	354	0.7095	0.314612	354	0.01316	0.12322	354	-0.6921	0.328775	354	34.86	159.72
369-250	79	1.65886	0.321124	79	-0.09169	0.163756	79	-1.6466	0.329836	79	0	16.51
370-542	104	1.25166	0.471701	104	-0.03898	0.144021	104	-1.2403	0.478309	104	119.38	226.29
371-293	256	1.13953	0.498221	256	-0.04979	0.155249	256	-1.1262	0.501886	256	67.96	182.89
372-736	284	1.10404	0.508608	284	-0.04171	0.148571	284	-1.0916	0.512025	284	63.87	224.35
373-945	345	1.06699	0.469069	345	-0.02673	0.138882	345	-1.0533	0.478686	345	68.49	195.88
374-067	287	0.53004	0.29791	287	0.00367	0.10293	287	-0.4846	0.352727	287	11.06	90.97
375-500	98	1.30293	0.447032	98	-0.00384	0.141429	98	-1.2939	0.450987	98	0	0
376-359	280	1.24869	0.480798	280	-0.0232	0.113491	280	-1.2415	0.485485	280	81.6	213.54
377-331	65	0.82306	0.376814	65	-0.05437	0.199967	65	-0.7957	0.379389	65	126.38	216.79
378-483	162	1.37265	0.482452	162	-0.0293	0.165897	162	-1.3621	0.483158	162	118.83	243.63
379-847	359	0.66884	0.305632	359	0.04352	0.125736	359	-0.6525	0.311992	359	0	0
380-275	335	0.59669	0.282598	335	0.02321	0.141083	335	-0.557	0.324569	335	-0.01	1.32
381-588	63	1.24783	0.390477	63	0.06606	0.090555	63	-1.2427	0.391059	63	110.41	244.63
382-406	201	1.04494	0.548043	201	-0.05221	0.146996	201	-1.0231	0.566869	201	110.61	212.76
383-284	68	0.85319	0.351541	68	0.05953	0.149588	68	-0.8371	0.353921	68	217.49	355.78

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
384-597	273	0.57562	0.308018	273	-0.00203	0.111174	273	-0.5613	0.314459	273	3.11	27.78
385-278	274	1.22306	0.470961	274	-0.05093	0.135186	274	-1.2124	0.476507	274	78.08	243.07
386-521	392	0.64229	0.297406	392	0.02813	0.141999	392	-0.6175	0.314352	392	-0.57	11.36
387-255	243	1.34948	0.431603	243	-0.0154	0.14189	243	-1.3413	0.433694	243	46.18	229.99
388-865	104	0.42652	0.236393	104	-0.01936	0.154577	104	-0.3335	0.320915	104	0	0
389-149	178	1.19752	0.38781	178	0.01646	0.156609	178	-1.1761	0.420484	178	173.61	338
390-454	223	1.08902	0.527827	223	-0.03671	0.177562	223	-1.0648	0.546095	223	95.35	232.83
391-737	356	0.64125	0.318671	356	0.03179	0.135488	356	-0.6085	0.35096	356	21.38	127.16
392-599	105	1.44853	0.49623	105	-0.10684	0.110002	105	-1.4385	0.501947	105	0	0
393-562	313	1.20688	0.458342	313	-0.01769	0.146459	313	-1.1962	0.462555	313	66.2	233.66
394-499	501	0.61938	0.246035	501	0.06537	0.124541	501	-0.6	0.253752	501	-46.25	165.49
395-321	402	1.12891	0.510265	402	-0.02831	0.173425	402	-1.112	0.517102	402	67.83	197.21
396-946	501	0.66422	0.283648	501	0.07333	0.117863	501	-0.647	0.28941	501	-27.51	98.51
397-315	311	0.61176	0.271797	311	0.07209	0.115347	311	-0.594	0.277197	311	0	0
398-299	501	0.68601	0.287524	501	0.06546	0.117125	501	-0.6706	0.292494	501	-2.23	33.69
399-381	317	1.12402	0.43462	317	-0.0841	0.112188	317	-1.1142	0.437266	317	12.82	67.92
400-818	501	0.64779	0.287258	501	0.06081	0.120449	501	-0.6291	0.296926	501	0	0
401-683	236	1.29058	0.466118	236	0.0007	0.107939	236	-1.2854	0.467877	236	3.56	78.64
402-035	243	0.55972	0.24725	243	0.06463	0.123051	243	-0.5398	0.252471	243	0	0
403-526	385	0.57268	0.277062	385	0.05959	0.113733	385	-0.5551	0.283061	385	-13.42	97.08
404-994	432	0.97376	0.410771	432	-0.05766	0.156518	432	-0.9552	0.42053	432	76.55	218.55
405-796	360	1.16917	0.456982	360	-0.01502	0.130104	360	-1.1602	0.461179	360	81.91	199.38
406-228	501	0.64571	0.290857	501	0.06846	0.121615	501	-0.6246	0.303193	501	-39.75	158.51
407-932	458	0.68063	0.304112	458	0.07371	0.117448	458	-0.6645	0.308179	458	-17.14	116.27
408-978	501	0.62262	0.254397	501	0.08023	0.137144	501	-0.5999	0.259368	501	-15.31	105.26
409-253	300	1.28205	0.455133	300	-0.02197	0.141058	300	-1.2738	0.455972	300	72.49	202.73
410-115	151	1.29557	0.459304	151	-0.01249	0.202581	151	-1.2753	0.471536	151	141.12	288.29
411-498	401	1.10289	0.583916	401	-0.03829	0.149202	401	-1.0854	0.596236	401	47.73	177.21

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
412-473	311	1.22406	0.478443	311	-0.06946	0.137361	311	-1.2118	0.484889	311	74.22	250.16
413-117	456	0.69185	0.296508	456	0.06804	0.120274	456	-0.6755	0.301986	456	-18.8	98.33
414-626	375	1.10767	0.415563	375	-0.04687	0.123473	375	-1.0986	0.418598	375	73.95	204.72
415-419	312	1.33906	0.460024	312	-0.03756	0.119704	312	-1.3319	0.463725	312	21.09	97.11
416-240	327	1.18703	0.423349	327	-0.0835	0.150887	327	-1.1717	0.431054	327	13.21	66.18
417-517	501	0.668	0.284758	501	0.07709	0.131849	501	-0.648	0.290034	501	-9.5	67.27
418-408	27	0.83987	0.304851	27	0.01766	0.086617	27	-0.8079	0.373816	27	-237.44	323.11
419-538	271	0.56351	0.246863	271	0.0742	0.119423	271	-0.5424	0.254154	271	0	0
420-076	323	1.27002	0.504497	323	-0.03733	0.134999	323	-1.2595	0.511501	323	73.09	219.54
421-435	275	1.29547	0.471705	275	-0.05648	0.122165	275	-1.2876	0.474045	275	8.81	72.21
422-785	274	1.27336	0.46537	274	-0.03825	0.136215	274	-1.2618	0.475283	274	48.75	189.28
423-562	267	0.53829	0.280628	267	-0.00904	0.146719	267	-0.4715	0.353373	267	-3.72	38.98
424-140	159	1.2775	0.462406	159	-0.05377	0.122148	159	-1.2697	0.464714	159	0	0
425-577	186	1.17664	0.542955	186	-0.03942	0.129849	186	-1.1683	0.544015	186	96.82	233.22
426-766	376	0.6	0.279615	376	0.02907	0.135093	376	-0.5827	0.282237	376	0	0
427-933	333	0.59686	0.267981	333	0.02989	0.125338	333	-0.5805	0.273072	333	-12.52	99.35
428-383	202	1.13271	0.518006	202	-0.07643	0.136441	202	-1.1173	0.527961	202	91.92	222.11
429-328	168	1.23726	0.417943	168	0.00423	0.158548	168	-1.2221	0.432368	168	102.93	256.06
430-841	94	0.83349	0.352628	94	0.02387	0.149389	94	-0.8194	0.353446	94	72.77	195.15
431-188	124	0.97252	0.45269	124	0.04848	0.134885	124	-0.959	0.459026	124	103.82	235.04
432-814	348	0.53626	0.269614	348	0.02393	0.130124	348	-0.5058	0.294961	348	0	0
433-244	197	1.05146	0.561471	197	-0.03792	0.158024	197	-1.0291	0.579361	197	76.79	199.14
434-492	92	1.48318	0.472301	92	-0.06929	0.136377	92	-1.4746	0.474765	92	0	0
435-977	429	0.57294	0.271066	429	0.04626	0.135663	429	-0.5507	0.279268	429	0	0
436-204	77	0.88431	0.28255	77	0.03003	0.148912	77	-0.8698	0.287355	77	162.68	269.06
437-619	381	0.65742	0.30276	381	0.03867	0.128489	381	-0.6267	0.336537	381	0	0
438-970	104	1.00331	0.435492	104	0.05366	0.123373	104	-0.9929	0.438757	104	166.38	246.4
439-305	394	0.64356	0.276833	394	0.0278	0.139908	394	-0.6238	0.28532	394	0	0

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
440-918	266	1.20435	0.484451	266	-0.03876	0.115221	266	-1.197	0.487351	266	70.29	218.56
441-154	172	1.15319	0.491006	172	-0.05818	0.178869	172	-1.1264	0.516826	172	182.09	366.07
442-318	432	0.65474	0.29729	432	0.0363	0.141671	432	-0.636	0.30206	432	16.78	100.95
443-477	183	1.30862	0.568901	183	-0.06065	0.142498	183	-1.2977	0.573045	183	95	241.21
444-560	318	1.17964	0.480302	318	-0.0299	0.126102	318	-1.1724	0.480598	318	65.44	203.15
445-328	281	1.28878	0.468466	281	-0.0484	0.120179	281	-1.2815	0.470572	281	97.81	358.94
446-276	288	1.17347	0.449454	288	-0.01656	0.125418	288	-1.1654	0.452765	288	84.14	249.63
447-340	142	1.34612	0.352477	142	0.0291	0.153293	142	-1.3365	0.354746	142	231.2	410.73
448-535	402	0.58813	0.265436	402	0.03339	0.131749	402	-0.5698	0.270682	402	0	0
449-305	150	1.19943	0.464604	150	-0.03536	0.152506	150	-1.1824	0.481903	150	129.91	264.5
450-719	169	1.24656	0.496991	169	-0.05912	0.133436	169	-1.2363	0.501254	169	36.18	133.83
451-305	21	1.18359	0.479806	21	0.0179	0.184741	21	-1.1675	0.485188	21	0	0
452-784	115	1.52891	0.433905	115	-0.02357	0.140291	115	-1.518	0.448955	115	122.87	244.41
453-306	348	0.60614	0.296232	348	0.02623	0.125812	348	-0.5882	0.304482	348	-4.58	34.91
454-954	204	1.10705	0.420116	204	-0.01361	0.148861	204	-1.0953	0.424335	204	-1.97	38.52
455-806	400	0.484	0.157974	400	-0.01373	0.129284	400	-0.4644	0.163359	400	-19.99	72.65
456-145	213	1.13217	0.470316	213	0.03859	0.145118	213	-1.1193	0.477171	213	87.58	194.91
457-251	146	0.43406	0.198722	146	0.07885	0.132826	146	-0.3615	0.271493	146	51.23	163.77
458-016	377	0.62438	0.322765	377	0.05207	0.140158	377	-0.6058	0.323577	377	55.9	191.78
459-072	57	1.01323	0.493884	57	0.01215	0.121192	57	-1.0041	0.497863	57	132.14	465.3
460-323	307	0.42506	0.195693	307	0.03825	0.123877	307	-0.3938	0.217128	307	-18.85	39.9
461-174	7	0.57486	0.12305	7	0.12536	0.113491	7	-0.5542	0.105501	7	-207.14	222.07
462-738	103	1.02075	0.279852	103	0.01303	0.157121	103	-1.0083	0.281151	103	174.56	280.9
463-694	96	0.92746	0.364509	96	0.02293	0.156051	96	-0.8959	0.407689	96	166.59	290.47
464-914	157	1.06824	0.406294	157	0.00234	0.120699	157	-1.0618	0.405323	157	130.18	217.04
465-208	215	0.63764	0.270864	215	0.00214	0.105986	215	-0.6224	0.285462	215	-103.81	238.02
466-210	501	0.59284	0.260481	501	0.02236	0.116595	501	-0.5795	0.263482	501	31.82	133.16
467-090	140	1.00995	0.411261	140	0.02516	0.090657	140	-1.0054	0.411701	140	137.89	255.82

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
468-301	43	0.63518	0.23535	43	-0.03227	0.098539	43	-0.6224	0.247129	43	-209.3	283.74
469-617	276	0.72065	0.293267	276	0.04893	0.12698	276	-0.7014	0.308078	276	50.51	171.03
470-522	154	0.93684	0.366438	154	-0.02568	0.126929	154	-0.9254	0.372679	154	-72.42	179.64
471-775	161	1.15836	0.385054	161	0.01404	0.126742	161	-1.1505	0.387567	161	131.51	268.56
472-963	488	0.59414	0.261404	488	0.03282	0.126215	488	-0.5756	0.270375	488	33.76	128.18
473-702	153	0.81952	0.317665	153	-0.03521	0.131684	153	-0.8057	0.323919	153	-85.99	180.01
474-527	75	0.59548	0.096442	75	0.06468	0.086957	75	-0.5852	0.099215	75	-179.41	233.86
475-635	92	0.75468	0.316656	92	0.0486	0.140652	92	-0.7289	0.341671	92	-158.74	210.04
476-870	130	0.926	0.272684	130	-0.02807	0.125541	130	-0.9163	0.275443	130	-129.35	255.78
477-587	180	0.63992	0.323939	180	0.04982	0.143994	180	-0.6056	0.353172	180	58.86	177.48
478-231	189	0.84953	0.409969	189	-0.01441	0.134346	189	-0.8313	0.42505	189	19.1	164.88
479-579	233	0.54516	0.282307	233	0.07567	0.113489	233	-0.5225	0.292246	233	8.26	90.9
480-096	334	0.75901	0.329112	334	0.0336	0.12699	334	-0.7464	0.33185	334	24.87	156.48
481-529	210	0.9842	0.425536	210	-0.02007	0.131315	210	-0.9723	0.432297	210	4.72	185.89
482-804	362	0.70229	0.331088	362	0.02686	0.131885	362	-0.6798	0.350164	362	11.88	131.13
483-348	318	0.92787	0.421039	318	-0.00565	0.126654	318	-0.9161	0.427738	318	-41.29	172.72
484-922	158	1.26655	0.412203	158	0.05293	0.145894	158	-1.255	0.418406	158	132.72	290.87
485-973	220	0.65967	0.304316	220	0.02007	0.133555	220	-0.6421	0.311987	220	58.88	228.63
486-235	140	1.12684	0.452344	140	-0.00019	0.154271	140	-1.1109	0.465564	140	83.71	222.32
487-425	280	1.10908	0.419965	280	-0.01701	0.114177	280	-1.1017	0.423485	280	-55.12	258.4
488-081	188	0.86359	0.385989	188	-0.01354	0.137098	188	-0.8472	0.397827	188	3.71	216.52
489-263	143	1.14527	0.446391	143	0.00525	0.144768	143	-1.1308	0.459964	143	126.55	286.48
490-272	94	0.65726	0.279624	94	-0.04771	0.135087	94	-0.6383	0.287263	94	-76.03	195.91
491-863	379	0.68754	0.308363	379	0.01282	0.131421	379	-0.6697	0.319269	379	39.28	191.1
492-910	419	0.60671	0.295559	419	0.01793	0.120595	419	-0.5928	0.298661	419	3.06	138.95
493-301	444	0.61292	0.304199	444	0.01987	0.132195	444	-0.5948	0.31072	444	16.59	199.68
494-303	316	0.90339	0.340948	316	-0.03714	0.131736	316	-0.8929	0.341099	316	-4.38	170.87
495-398	213	0.93185	0.341634	213	0.00776	0.124255	213	-0.9219	0.345923	213	-42.62	154.08

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
496-866	203	0.6693	0.337826	203	0.09386	0.124306	203	-0.6488	0.341997	203	19.14	80.87
497-628	175	0.80979	0.358568	175	-0.03735	0.143043	175	-0.7927	0.366372	175	59.09	215.16
498-469	8	0.40855	0.104618	8	0.01931	0.100931	8	-0.3967	0.10583	8	-83.38	133.54
499-709	351	0.47504	0.320109	351	-0.00993	0.116677	351	-0.4473	0.33828	351	10.34	62.55
500-849	212	0.50803	0.265044	212	-0.01467	0.106703	212	-0.4924	0.272618	212	-9.33	68.27
501-920	305	0.56247	0.340222	305	-0.00535	0.103336	305	-0.5367	0.365376	305	38.94	114.87
502-319	65	0.58469	0.258619	65	-0.07971	0.08755	65	-0.5616	0.282127	65	-95.97	137.59
503-703	501	0.6715	0.266433	501	0.05974	0.114795	501	-0.6568	0.271644	501	0	0
504-288	170	1.33094	0.421916	170	-0.01975	0.155653	170	-1.3213	0.423093	170	0	0
505-107	473	0.69025	0.28733	473	0.06643	0.107185	473	-0.6769	0.291495	473	-31.93	94.59
506-368	354	0.57258	0.27383	354	0.05052	0.127133	354	-0.553	0.279865	354	0	0
507-812	242	1.10552	0.426921	242	-0.00495	0.12931	242	-1.0962	0.43144	242	-6.02	199.7
508-733	463	0.70383	0.310889	463	0.07099	0.11893	463	-0.6706	0.351044	463	-23.61	80.98
509-516	146	1.40045	0.420734	146	-0.04467	0.133056	146	-1.3934	0.420937	146	-32.68	100.7
510-215	300	1.00518	0.349852	300	-0.0051	0.153233	300	-0.9906	0.358001	300	90.55	183.91
511-061	379	1.02638	0.378658	379	-0.08363	0.122046	379	-1.0143	0.382356	379	37.62	122.97
512-115	240	1.19423	0.458618	240	-0.03988	0.185528	240	-1.1612	0.502333	240	56.25	171.96
513-926	501	0.6197	0.280238	501	0.02458	0.117907	501	-0.6021	0.292508	501	-27	108.42
514-344	58	0.82057	0.371952	58	0.11822	0.184491	58	-0.7852	0.384568	58	161.93	161.55
515-900	372	0.48795	0.244711	372	0.06667	0.122383	372	-0.466	0.247954	372	3.16	36.49
516-503	26	0.54953	0.178927	26	0.16003	0.062641	26	-0.5222	0.178773	26	-196.08	128.95
517-743	297	1.19677	0.381037	297	-0.00361	0.103843	297	-1.1914	0.383627	297	38.15	105.64
518-143	88	0.54897	0.162012	88	-0.10573	0.084522	88	-0.5303	0.167923	88	-171.83	161.78
519-510	288	1.04573	0.447282	288	-0.02138	0.142701	288	-1.0263	0.468717	288	100.93	207.94
520-502	112	0.83406	0.204907	112	0.02701	0.16741	112	-0.8131	0.219338	112	207.56	320.94
521-590	501	0.63152	0.273429	501	0.07359	0.122835	501	-0.6128	0.278618	501	-21.13	88.49
522-155	397	0.51455	0.258684	397	0.06276	0.122502	397	-0.493	0.264083	397	0	0
523-114	323	0.72441	0.299626	323	0.0292	0.120936	323	-0.7104	0.30729	323	-37.05	180.48

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
524-007	186	0.84177	0.315656	186	0.02269	0.108885	186	-0.8305	0.32582	186	53.35	195.9
525-785	249	0.84126	0.356721	249	0.07733	0.1136	249	-0.8269	0.363885	249	-11.84	93.25
526-148	287	1.28835	0.529394	287	-0.02015	0.117417	287	-1.279	0.538617	287	54.13	284.41
527-178	247	0.91731	0.364227	247	-0.04403	0.121644	247	-0.9051	0.371819	247	6.37	285.65
528-496	105	1.02826	0.385793	105	0.0338	0.118897	105	-1.019	0.39062	105	134.03	217.29
529-326	224	0.53083	0.297491	224	-0.03445	0.109245	224	-0.5047	0.320254	224	0	0
530-342	271	0.5731	0.303338	271	0.01075	0.121804	271	-0.5543	0.313598	271	-3.72	25.58
531-440	260	1.14865	0.554864	260	-0.02843	0.139706	260	-1.1371	0.56045	260	75.53	165.88
532-169	259	1.41937	0.495858	259	-0.03538	0.154269	259	-1.4107	0.4954	259	93.44	268.03
533-722	116	0.94446	0.37631	116	0.02463	0.123281	116	-0.934	0.381483	116	106.03	229.68
534-364	105	1.12867	0.398058	105	0.03796	0.130444	105	-1.1196	0.400726	105	198.53	323.26
535-434	202	0.69125	0.330408	202	0.04136	0.109237	202	-0.6779	0.337531	202	-48.48	148.35
536-503	501	0.66227	0.334928	501	0.08458	0.113665	501	-0.6225	0.378533	501	-4.67	41.51
537-207	305	0.87342	0.323196	305	-0.06983	0.132232	305	-0.856	0.335193	305	26.09	148.93
538-126	132	0.4076	0.18935	132	0.08937	0.091735	132	-0.3858	0.191987	132	39.94	148.5
539-660	107	0.82306	0.508312	107	0.03565	0.18031	107	-0.5715	0.76075	107	141.04	170.77
540-975	279	0.39909	0.203741	279	0.01298	0.104002	279	-0.3678	0.2337	279	0	0
541-379	353	1.01618	0.383058	353	-0.08823	0.109557	353	-1.0057	0.384963	353	36.25	119.61
542-918	207	0.57913	0.318661	207	0.08609	0.094706	207	-0.5576	0.331305	207	-104.6	210.86
543-674	27	0.52331	0.198387	27	0.12273	0.088996	27	-0.5008	0.199443	27	0	0
544-145	96	0.96185	0.348243	96	0.03851	0.141448	96	-0.9488	0.353558	96	87.9	186.28
545-226	84	0.8319	0.137551	84	0.03437	0.138277	84	-0.8191	0.141334	84	-225.19	315.33
546-116	134	1.15457	0.337399	134	0.02269	0.132934	134	-1.1447	0.344126	134	118.63	262.58
547-771	150	0.98344	0.427033	150	0.00457	0.115107	150	-0.9767	0.427085	150	131.63	188.76
548-571	99	0.9664	0.190675	99	0.00689	0.171171	99	-0.95	0.197088	99	130.75	241.55
549-063	234	1.26118	0.463739	234	-0.02507	0.152775	234	-1.2514	0.464502	234	35.92	134.81
550-538	431	0.44543	0.226111	431	0.00629	0.131595	431	-0.404	0.262775	431	-4.32	30.31
551-021	154	0.69731	0.244367	154	0.06314	0.127048	154	-0.678	0.257554	154	-5.81	115.3

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
552-828	286	1.13044	0.451321	286	-0.00166	0.15167	286	-1.117	0.459411	286	65.73	186.08
553-234	303	1.06337	0.425154	303	-0.08509	0.126485	303	-1.0511	0.428315	303	70.48	179.24
554-126	116	0.52317	0.277351	116	0.00198	0.127115	116	-0.502	0.28749	116	-22.29	79.67
555-990	330	1.16108	0.443689	330	-0.00136	0.119221	330	-1.1517	0.452154	330	73.73	201.49
556-921	336	1.12342	0.426752	336	-0.0352	0.113478	336	-1.1135	0.436258	336	57.18	191.14
557-102	233	1.19498	0.492025	233	0.01447	0.174774	233	-1.1819	0.492571	233	65.13	183.82
558-139	263	0.65565	0.331172	263	0.0625	0.153551	263	-0.6163	0.363856	263	-48.13	128.5
559-848	345	1.2149	0.373831	345	-0.06383	0.142586	345	-1.2038	0.37713	345	9.27	80.13
560-192	39	0.56329	0.19267	39	0.11189	0.146231	39	-0.533	0.19241	39	-378.87	344.86
561-369	191	1.17572	0.38722	191	0.00767	0.118356	191	-1.1678	0.393182	191	120.81	229.96
562-426	135	0.67908	0.390296	135	0.01704	0.108444	135	-0.6641	0.400741	135	-41.44	161.73
563-805	115	0.58561	0.244386	115	0.04556	0.129908	115	-0.5527	0.28019	115	-27.35	94
564-979	99	0.95858	0.392728	99	-0.09772	0.140929	99	-0.9385	0.403942	99	15.39	202.74
565-987	112	1.01499	0.34018	112	-0.08597	0.265414	112	-0.9704	0.356669	112	70.98	267.74
566-659	171	0.74737	0.413432	171	-0.01788	0.117206	171	-0.7284	0.430088	171	27.28	216.74
567-456	228	0.57812	0.26631	228	0.1089	0.125646	228	-0.547	0.279966	228	1.04	236.58
568-183	183	0.75657	0.330121	183	-0.04723	0.149132	183	-0.7339	0.344298	183	46.4	235.38
569-252	191	0.77044	0.370323	191	-0.06959	0.126267	191	-0.7489	0.386264	191	-13.79	160.65
570-951	163	0.89019	0.356201	163	-0.01668	0.157836	163	-0.8691	0.372861	163	-62.74	181.12
571-267	105	0.98575	0.3769	105	0.02965	0.154398	105	-0.9721	0.379768	105	98.7	229.45
572-409	119	1.15002	0.35426	119	0.02838	0.134199	119	-1.1401	0.35997	119	179.22	298.27
573-052	185	0.60392	0.281233	185	-0.00858	0.104445	185	-0.5854	0.30034	185	-106.91	248.01
574-100	94	0.64124	0.272865	94	-0.09783	0.086767	94	-0.6266	0.275699	94	-90.67	186.37
575-878	97	0.7587	0.364834	97	-0.07646	0.12018	97	-0.7398	0.376039	97	-69.1	164.37
576-826	100	1.0032	0.328744	100	0.03766	0.137825	100	-0.9916	0.333184	100	86.89	217.27
577-314	111	0.81387	0.226038	111	0.01729	0.14247	111	-0.7995	0.232117	111	76.95	192.84
578-907	263	0.62366	0.277345	263	0.09028	0.122651	263	-0.6032	0.280956	263	-59.41	178.27
579-388	240	0.92631	0.396871	240	-0.01935	0.137974	240	-0.9118	0.40612	240	61.52	236.72

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
580-672	106	0.73971	0.280714	106	-0.04978	0.142974	106	-0.7227	0.284565	106	9.2	62.23
581-352	140	0.59839	0.333254	140	0.06137	0.097234	140	-0.582	0.342416	140	-123.64	243.3
582-554	186	1.22718	0.414005	186	-0.01632	0.121139	186	-1.2201	0.416902	186	22.86	134.77
583-365	173	0.84988	0.416228	173	-0.02283	0.127891	173	-0.8341	0.427799	173	-74.4	181.72
584-025	254	0.68493	0.281092	254	0.04957	0.134715	254	-0.6669	0.287758	254	52.19	169.02
585-170	98	0.63054	0.254728	98	-0.08032	0.115953	98	-0.6062	0.274508	98	-98.29	185.15
586-160	193	0.53637	0.326385	193	0.087	0.088216	193	-0.5133	0.339762	193	-131.3	250.56
587-959	189	0.82609	0.433275	189	-0.03017	0.118693	189	-0.8121	0.442397	189	-76.23	142.84
588-618	240	0.96104	0.414911	240	-0.01364	0.167331	240	-0.9431	0.422319	240	53.17	195.93
589-260	65	0.5012	0.354277	65	0.07603	0.09219	65	-0.4702	0.376483	65	-239.31	341.44
590-826	84	1.53392	0.319055	84	-0.05104	0.115184	84	-1.5287	0.319396	84	26.46	101.23
591-859	246	0.75646	0.297939	246	0.06794	0.110765	246	-0.7402	0.310426	246	-76.74	228.98
592-552	272	0.6537	0.312226	272	0.09373	0.132754	272	-0.6301	0.318476	272	-23.21	257.27
593-509	242	0.98797	0.35798	242	0.02597	0.132918	242	-0.9775	0.361126	242	29.29	279.29
594-589	206	0.86211	0.420166	206	-0.02913	0.146313	206	-0.8439	0.43067	206	-8.43	178.45
595-573	220	0.64388	0.31319	220	0.01037	0.092672	220	-0.6292	0.328823	220	-52.55	256.4
596-056	251	0.67083	0.265025	251	0.07623	0.121345	251	-0.6543	0.267694	251	-83.15	223.15
597-965	260	0.58895	0.287364	260	0.10002	0.118434	260	-0.5643	0.295069	260	-80.7	222.29
598-265	84	0.68099	0.198839	84	-0.05886	0.151021	84	-0.6608	0.201519	84	-75.75	167.33
599-465	94	0.7913	0.355219	94	-0.05939	0.131753	94	-0.7729	0.366586	94	-73.77	162.31
600-673	200	0.63248	0.348195	200	-0.00014	0.075712	200	-0.6205	0.361473	200	-87	211.29
601-451	213	0.6434	0.319157	213	0.0168	0.085408	213	-0.6348	0.32462	213	-89.41	212.77
602-770	102	0.70311	0.270227	102	-0.06346	0.124338	102	-0.6855	0.279662	102	-57.62	148.3
603-934	212	1.11496	0.387315	212	0.02398	0.125097	212	-1.1055	0.393623	212	54.15	185.97
604-270	168	0.87889	0.447318	168	-0.00404	0.133104	168	-0.8652	0.454256	168	-78.22	157.72
605-955	174	0.84158	0.417445	174	-0.02375	0.134289	174	-0.8252	0.428007	174	-72.05	152.31
606-218	172	0.83521	0.396348	172	-0.02634	0.128049	172	-0.8215	0.40356	172	-45.26	130.49
607-704	162	0.47629	0.220352	162	0.09287	0.104124	162	-0.4466	0.237888	162	19.79	150.81

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
608-478	175	0.44951	0.179768	175	0.10316	0.129887	175	-0.4041	0.2091	175	-1.15	121.74
609-426	241	0.53722	0.36235	241	-0.02082	0.134222	241	-0.4997	0.389718	241	3.12	180.76
610-472	101	0.88813	0.302737	101	-0.15908	0.105756	101	-0.8673	0.302973	101	-195.63	351.71
611-066	249	0.66914	0.311771	249	0.11906	0.136013	249	-0.6417	0.317063	249	33.97	287
612-416	59	1.70334	0.195803	59	-0.00869	0.157161	59	-1.695	0.206184	59	39.8	154.9
613-751	209	0.69944	0.343599	209	-0.00816	0.103013	209	-0.6865	0.354062	209	-73.21	217.8
614-256	116	0.66083	0.312039	116	-0.07738	0.113653	116	-0.645	0.31508	116	-124.67	202.8
615-526	112	0.91152	0.296211	112	0.02011	0.126009	112	-0.9013	0.300228	112	144.85	245.57
616-159	100	0.79802	0.283141	100	-0.01705	0.141418	100	-0.782	0.292253	100	116.88	226.02
617-602	100	0.95331	0.283361	100	0.01452	0.127483	100	-0.9438	0.286501	100	138.47	253.6
618-373	119	0.58876	0.285798	119	-0.09193	0.104363	119	-0.5633	0.303121	119	-76.74	176.61
619-943	194	0.99669	0.491944	194	-0.04835	0.149048	194	-0.9809	0.498793	194	34.68	155.07
620-969	176	0.85241	0.429991	176	-0.0238	0.137795	176	-0.8339	0.443568	176	-62.21	150.58
621-125	275	0.67365	0.29336	275	0.04085	0.125728	275	-0.6547	0.306395	275	44.73	135.81
622-378	204	0.70403	0.331404	204	-0.0389	0.127592	204	-0.6705	0.371996	204	-14.55	235.12
623-769	187	0.76091	0.361963	187	-0.02456	0.138218	187	-0.7365	0.384805	187	-44.73	119.35
624-665	58	0.6469	0.262573	58	0.05039	0.15332	58	-0.6291	0.256774	58	0	0
625-741	225	1.17732	0.520791	225	-0.00306	0.138053	225	-1.1647	0.530808	225	103.62	214.34
626-742	246	1.0221	0.485568	246	-0.0268	0.131805	246	-1.0094	0.493646	246	83.75	226.33
627-752	267	0.63842	0.290519	267	0.09161	0.107767	267	-0.6172	0.301856	267	-87.91	194.82
628-332	243	1.08749	0.465032	243	-0.00736	0.129038	243	-1.0768	0.472046	243	99.66	256.75
629-947	241	1.07502	0.496037	241	-0.01028	0.142135	241	-1.0497	0.529021	241	108.18	264.32
630-355	139	1.2478	0.374907	139	-0.01611	0.128527	139	-1.2407	0.376418	139	150.2	307.18
631-410	224	1.11493	0.491604	224	-0.01897	0.124708	224	-1.1027	0.502907	224	79.25	240.18
632-569	236	0.64307	0.284075	236	0.10722	0.106258	236	-0.6229	0.289037	236	-81.34	188.46
633-924	279	1.24871	0.478851	279	-0.01675	0.154856	279	-1.2376	0.482559	279	71.42	255.01
634-840	340	1.02435	0.447624	340	-0.09147	0.140305	340	-1.008	0.453501	340	46.76	187.27
635-113	298	1.38443	0.471142	298	-0.03753	0.123333	298	-1.3774	0.474039	298	30.17	139.46

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
636-263	320	1.20419	0.45464	320	-0.05097	0.13135	320	-1.1932	0.461912	320	56.16	226.31
637-272	289	0.62682	0.267939	289	0.0597	0.105132	289	-0.6121	0.274632	289	-53.33	155.31
638-237	501	0.6381	0.258313	501	0.04238	0.126925	501	-0.6203	0.266977	501	-22.48	92.67
639-968	123	1.24971	0.413021	123	-0.00533	0.12338	123	-1.2428	0.415464	123	192.93	317.8
640-827	194	0.74424	0.312003	194	0.01732	0.090391	194	-0.7351	0.320087	194	-101.08	200.83
641-805	157	1.3563	0.432222	157	-0.00499	0.168074	157	-1.3457	0.432892	157	164.85	304.52
642-888	73	1.2792	0.452294	73	-0.10995	0.130057	73	-1.2652	0.459917	73	0	0
643-258	501	0.70238	0.2919	501	0.04227	0.117695	501	-0.6898	0.295189	501	-43.81	156.54
644-220	312	1.32418	0.507233	312	-0.04598	0.133736	312	-1.3138	0.514588	312	64.02	241.62
645-692	325	1.12712	0.431639	325	-0.0329	0.113693	325	-1.1192	0.435965	325	84.95	228.52
646-442	501	0.67252	0.289119	501	0.07154	0.10861	501	-0.658	0.293323	501	-14.32	74.28
647-542	500	0.6606	0.290248	500	0.08086	0.126097	500	-0.6346	0.309093	500	-22.3	96.5
648-224	473	0.73123	0.32121	473	0.06268	0.115741	473	-0.7173	0.325614	473	-46.42	156.01
649-687	372	0.9996	0.514001	372	-0.05304	0.150881	372	-0.9802	0.526391	372	56.22	194.33
650-495	309	1.22167	0.445483	309	-0.01835	0.1298	309	-1.2142	0.446791	309	25.47	139.77
651-653	501	0.6519	0.261973	501	0.05092	0.123381	501	-0.6347	0.270057	501	4.89	54.4
652-068	141	1.51841	0.404626	141	0.01029	0.094029	141	-1.5153	0.405153	141	0	0
653-262	174	0.52413	0.279274	174	0.00525	0.11853	174	-0.5064	0.286904	174	0.85	99
654-717	317	1.29662	0.498701	317	-0.0421	0.136637	317	-1.2868	0.503801	317	61.08	228.36
655-693	401	0.57252	0.267649	401	0.05983	0.122892	401	-0.5523	0.27531	401	0	0
656-645	296	1.30374	0.507121	296	-0.05171	0.110369	296	-1.2964	0.511234	296	73.31	249.3
657-717	501	0.59996	0.256557	501	0.09874	0.118512	501	-0.5772	0.262521	501	-14.96	59.81
658-222	403	0.51886	0.249824	403	0.05976	0.119146	403	-0.4982	0.256272	403	-5.13	47.66
659-006	259	1.08536	0.411578	259	-0.08084	0.138043	259	-1.072	0.415688	259	8.97	60.87
660-404	404	1.13472	0.429086	404	-0.07103	0.173568	404	-1.1181	0.431696	404	66.98	269.44
661-113	315	1.31948	0.484388	315	-0.05764	0.116004	315	-1.3113	0.489368	315	60.32	233.69
662-384	324	1.10674	0.452133	324	-0.08126	0.128286	324	-1.0939	0.457992	324	48.48	182.08
663-068	501	0.64997	0.281709	501	0.07199	0.121652	501	-0.6323	0.286571	501	-32.8	120.32

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
664-646	330	1.13119	0.479045	330	-0.08261	0.126749	330	-1.1177	0.48694	330	57.23	225.99
665-185	215	0.64209	0.252088	215	0.04264	0.122294	215	-0.625	0.261685	215	-85.67	199.27
666-764	300	1.28622	0.51434	300	-0.05812	0.129126	300	-1.2763	0.519506	300	65.98	239.37
667-401	409	0.56683	0.278292	409	0.05979	0.126446	409	-0.5476	0.28174	409	-13.26	77.6
668-939	308	1.29022	0.466841	308	-0.0618	0.133173	308	-1.2801	0.471648	308	91.91	277.6
669-024	498	0.66181	0.274655	498	0.04833	0.115443	498	-0.6468	0.281938	498	-17.88	89.31
670-711	323	1.12133	0.448439	323	-0.09165	0.117657	323	-1.1096	0.45282	323	73.23	260.31
671-085	501	0.64462	0.277824	501	0.06612	0.125543	501	-0.6256	0.285051	501	-33.65	127.77
672-184	254	0.83053	0.345315	254	-0.00428	0.146106	254	-0.8113	0.360036	254	4.73	246.61
673-853	158	0.54091	0.274424	158	0.08482	0.085528	158	-0.5214	0.285753	158	-125.03	279.44
674-882	389	0.62861	0.312991	389	0.05314	0.122318	389	-0.6122	0.31713	389	34.73	115.34
675-131	154	0.70161	0.266412	154	-0.03845	0.142479	154	-0.6824	0.27549	154	28.06	177.21
676-298	202	0.75469	0.367479	202	0.04648	0.145093	202	-0.737	0.372034	202	34.38	130.4
677-502	226	0.71136	0.330388	226	0.08958	0.11736	226	-0.6954	0.331375	226	33.79	326.75
678-532	103	0.74877	0.29205	103	0.0313	0.095183	103	-0.7416	0.293278	103	-148.86	227.52
679-886	128	1.05656	0.403244	128	0.02037	0.128609	128	-1.0473	0.406554	128	79.7	212.64
680-800	59	1.6839	0.324094	59	-0.08188	0.143388	59	-1.6638	0.382076	59	0	0
681-509	108	0.76215	0.386299	108	-0.06289	0.151866	108	-0.7276	0.417215	108	-80.43	165.66
682-077	178	1.14239	0.575242	178	-0.07744	0.136099	178	-1.1275	0.58347	178	89.01	206.18
683-399	143	1.35362	0.580157	143	-0.02368	0.163117	143	-1.3357	0.59838	143	12.06	79.74
684-511	74	0.70048	0.38318	74	-0.02555	0.168219	74	-0.6704	0.399632	74	-90.61	154.76
685-619	123	0.5166	0.269968	123	0.06986	0.108757	123	-0.4995	0.271351	123	74.46	174.74
686-951	154	1.2884	0.453638	154	0.00355	0.124083	154	-1.2808	0.45827	154	128.71	267.49
687-289	235	0.64298	0.2805	235	0.05436	0.092899	235	-0.6303	0.288614	235	-71.43	202.11
688-213	348	1.0946	0.457021	348	-0.04945	0.12643	348	-1.0853	0.459186	348	65.7	259.37
689-202	83	0.64629	0.271323	83	-0.01711	0.115457	83	-0.6327	0.278604	83	140.24	246.13
690-909	250	1.05493	0.44332	250	-0.01994	0.129357	250	-1.0442	0.44952	250	-3.37	211.44
691-597	99	1.55218	0.372972	99	-0.01818	0.172111	99	-1.5432	0.370432	99	-15.03	87.11

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
692-848	156	1.2654	0.435238	156	-0.00077	0.16706	156	-1.2545	0.434851	156	122.1	327.57
693-610	153	1.06375	0.388493	153	0.02181	0.172168	153	-1.045	0.400822	153	55.59	182.34
694-631	215	0.90472	0.353835	215	0.01481	0.102785	215	-0.8968	0.358704	215	46.38	140.37
695-017	258	0.61469	0.323982	258	0.07554	0.110417	258	-0.5959	0.331476	258	-48.48	151.05
696-528	123	0.33772	0.090038	123	-0.12443	0.08976	123	-0.2968	0.103057	123	-65.28	85.9
697-740	96	0.86555	0.406203	96	0.0564	0.183504	96	-0.7627	0.545266	96	8.33	50.48
698-054	69	0.62889	0.274365	69	0.02081	0.159174	69	-0.6063	0.279059	69	0	0
699-164	409	0.52781	0.274867	409	0.05602	0.1333	409	-0.5062	0.277552	409	9.28	51.82
700-157	68	0.49716	0.275432	68	0.07045	0.057978	68	-0.4761	0.297138	68	-100.91	166.8
701-774	98	1.03426	0.427959	98	0.03465	0.122268	98	-1.0236	0.43484	98	248.66	409.94
702-773	243	0.60957	0.335015	243	-0.01663	0.139371	243	-0.5907	0.339597	243	-23.29	229.33
703-722	219	0.83296	0.329639	219	-0.02992	0.131276	219	-0.8219	0.330096	219	-7.08	238.86
704-978	31	0.98339	0.244481	31	0.06165	0.124062	31	-0.9728	0.249107	31	0	0
705-450	133	0.85584	0.362403	133	0.0733	0.138601	133	-0.839	0.368152	133	-19.12	87.7
706-403	211	0.84263	0.327711	211	-0.03375	0.118515	211	-0.8326	0.330295	211	-45.87	138.83
707-334	213	0.73001	0.154146	213	-0.07705	0.135275	213	-0.7095	0.170578	213	-8.92	208.65
708-317	108	0.6858	0.321126	108	0.03543	0.193476	108	-0.6476	0.340269	108	-21.18	98.98
709-855	345	0.49712	0.194936	345	-0.1118	0.124822	345	-0.4674	0.196641	345	-4.93	109.12
710-715	197	0.8232	0.255899	197	0.04453	0.114877	197	-0.814	0.25595	197	46.86	240.49
711-962	133	0.78065	0.446725	133	-0.00786	0.139883	133	-0.7608	0.459035	133	-80.93	160.34
712-412	140	0.83877	0.441987	140	0.01618	0.136024	140	-0.812	0.470182	140	-127.06	198.98
713-431	168	0.84167	0.454927	168	0.00262	0.129933	168	-0.8228	0.470788	168	-90.3	159.87
714-261	65	0.46406	0.222491	65	0.05365	0.13739	65	-0.42	0.259413	65	-117.06	156.11
715-839	132	1.34574	0.409816	132	0.00878	0.169616	132	-1.3323	0.41863	132	201.86	329.2
716-488	192	0.78129	0.324772	192	0.02983	0.110881	192	-0.771	0.329207	192	-84.26	211.53
717-331	204	0.63781	0.256371	204	-0.0218	0.107304	204	-0.6209	0.274149	204	32.06	182.49
718-144	160	0.48646	0.222847	160	0.11629	0.194502	160	-0.4256	0.232572	160	33.9	148.78
719-031	129	1.00669	0.337852	129	-0.03824	0.107616	129	-0.9984	0.343165	129	-82.23	183.71

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
720-529	152	1.06813	0.457294	152	0.04	0.108126	152	-1.062	0.457181	152	158.18	263.14
721-607	255	0.57777	0.272112	255	-0.00335	0.118261	255	-0.566	0.271288	255	-87.37	175.23
722-744	323	1.3362	0.466263	323	-0.02627	0.126504	323	-1.3298	0.466829	323	17.15	176.11
723-578	138	0.66178	0.34011	138	0.07579	0.104035	138	-0.5882	0.437903	138	15.95	118.08
724-307	141	0.66356	0.340849	141	-0.03266	0.081416	141	-0.6514	0.352913	141	-177.89	287.76
725-353	443	0.60811	0.248079	443	0.07529	0.117348	443	-0.5882	0.256827	443	-29.55	128.44
726-161	157	1.24651	0.472822	157	0.00005	0.193567	157	-1.2144	0.515364	157	58.57	197.72
727-329	433	0.7586	0.280227	433	0.06382	0.133595	433	-0.7434	0.281846	433	-35.44	230.98
728-128	129	0.66743	0.27973	129	-0.08053	0.105663	129	-0.6525	0.28352	129	-119.7	165.09
729-032	30	0.21078	0.081652	30	-0.08738	0.070592	30	-0.1206	0.157182	30	-81.27	109.26
730-564	337	0.68711	0.317964	337	0.0366	0.129946	337	-0.6455	0.372159	337	0	0
731-662	236	1.02407	0.364723	236	0.04759	0.120501	236	-1.0144	0.368708	236	58.6	214.79
732-002	152	0.46766	0.202618	152	-0.01641	0.102478	152	-0.4459	0.224179	152	-43.89	118.08
733-854	286	1.26058	0.493812	286	-0.05417	0.139957	286	-1.2479	0.50331	286	76.54	280.47
734-999	409	0.56222	0.286806	409	0.06086	0.133712	409	-0.5398	0.292371	409	16.32	98.03
735-089	372	0.47994	0.212839	372	0.04958	0.131766	372	-0.4569	0.217003	372	-42	135.69
736-266	123	0.39304	0.179872	123	-0.16504	0.133443	123	-0.3328	0.176633	123	0	0
737-893	115	1.41231	0.425987	115	0.00606	0.116332	115	-1.407	0.427804	115	-42.37	138
738-540	98	0.48627	0.230819	98	0.08495	0.087567	98	-0.4505	0.268715	98	-86.83	156.02
739-885	281	1.10671	0.424962	281	-0.08164	0.118937	281	-1.0956	0.429206	281	-78.71	180.9
740-817	277	1.02254	0.460538	277	-0.0486	0.214942	277	-0.9714	0.515693	277	74.43	188.59
741-834	306	1.15909	0.407945	306	-0.03002	0.103526	306	-1.1536	0.409229	306	60.27	235.52
742-556	204	0.50107	0.244258	204	-0.00543	0.08187	204	-0.4893	0.254222	204	-175.49	335.22
743-418	348	0.70315	0.307901	348	0.06459	0.107106	348	-0.691	0.310031	348	-14.05	74.84
744-337	139	1.1874	0.376875	139	-0.06001	0.169242	139	-1.1753	0.372131	139	247.68	534.96
745-582	501	0.68706	0.274056	501	0.07553	0.12236	501	-0.6691	0.280843	501	-13	67.44
746-414	345	0.62077	0.299776	345	0.04844	0.095195	345	-0.6105	0.301931	345	-43.41	141.1
747-306	101	0.63223	0.21606	101	-0.06399	0.115565	101	-0.615	0.225599	101	-236.85	273.1

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
748-401	215	1.06917	0.5357	215	-0.03276	0.151623	215	-1.054	0.543309	215	83.99	230.8
749-824	418	0.44614	0.178843	418	-0.01031	0.159981	418	-0.3977	0.217313	418	6.75	36.92
750-702	25	0.37567	0.111555	25	-0.04067	0.206431	25	-0.3153	0.107568	25	0	0
751-444	271	1.00921	0.453571	271	-0.06713	0.134529	271	-0.9963	0.457266	271	-19.51	112.27
752-549	335	0.97473	0.428968	335	-0.06948	0.129316	335	-0.9622	0.432187	335	82.33	168.41
753-073	224	0.54046	0.284986	224	0.01044	0.117876	224	-0.4807	0.358438	224	-11.55	59.36
754-566	104	1.06333	0.354019	104	0.00449	0.105141	104	-1.0574	0.356381	104	306.28	306.36
755-897	326	0.6719	0.201164	326	-0.00269	0.105661	326	-0.6629	0.203216	326	29.61	81.24
756-435	221	0.68497	0.377034	221	-0.00971	0.104178	221	-0.64	0.437086	221	2.25	32.18
757-550	363	0.49897	0.258065	363	0.06777	0.131797	363	-0.4753	0.260348	363	-6.03	146.85
758-320	134	1.06408	0.380201	134	-0.03684	0.143676	134	-1.0463	0.400389	134	-92.43	248.54
759-585	163	1.35517	0.292814	163	-0.11048	0.146534	163	-1.3415	0.298308	163	151.26	269
760-976	309	0.61118	0.307123	309	0.04505	0.133892	309	-0.5866	0.322349	309	-24.76	86.6
761-783	226	0.5712	0.303489	226	-0.01332	0.095482	226	-0.558	0.312662	226	-5.02	39.76
762-019	107	0.5903	0.218365	107	-0.10292	0.089108	107	-0.5686	0.233249	107	-197.95	164.46
763-603	491	0.68141	0.284747	491	0.08384	0.117449	491	-0.6649	0.287266	491	-26.27	104.76
764-202	419	0.72469	0.314614	419	0.08796	0.126771	419	-0.7025	0.326909	419	-70.91	205.76
765-201	259	0.27962	0.149614	259	-0.01797	0.115432	259	-0.2205	0.196037	259	-27.62	77.17
766-644	364	0.69193	0.29785	364	-0.06551	0.123359	364	-0.6737	0.306855	364	15.24	72.1
767-057	370	0.37644	0.245729	370	0.07431	0.119273	370	-0.3383	0.260628	370	-11.91	36.37
768-310	501	0.51805	0.230174	501	0.01689	0.122056	501	-0.5006	0.235898	501	-26.01	127.24
769-026	450	0.54899	0.241697	450	0.0372	0.107864	450	-0.5357	0.244559	450	-5.42	41.28
770-273	102	0.53954	0.225603	102	-0.01503	0.098605	102	-0.5251	0.237597	102	-129.91	186.69
771-684	341	1.11683	0.476766	341	-0.00336	0.15213	341	-1.0992	0.493343	341	77.65	158.85
772-827	275	0.2719	0.188741	275	-0.012	0.144714	275	-0.2232	0.196835	275	16.26	64.92
773-730	121	0.51582	0.096981	121	0.01348	0.182192	121	-0.4838	0.090936	121	-27.82	59.5
774-823	185	1.03879	0.296323	185	-0.00889	0.121901	185	-1.0312	0.297872	185	80.79	158.69
775-535	140	1.39494	0.428811	140	0.04819	0.153428	140	-1.3804	0.44561	140	190.11	381.17

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
776-763	56	1.10095	0.420271	56	-0.0448	0.132813	56	-1.0891	0.428309	56	0	0
777-744	304	0.91656	0.380344	304	-0.05234	0.124886	304	-0.9026	0.389631	304	84.05	181.64
778-726	371	0.52614	0.228245	371	0.02758	0.134966	371	-0.4878	0.2685	371	-3.74	127.2
779-991	243	1.36784	0.492889	243	-0.03481	0.136538	243	-1.361	0.49184	243	80.83	237.57
780-757	398	0.36204	0.214391	398	0.05054	0.109162	398	-0.3277	0.235001	398	-12.22	39.78
781-015	212	0.81783	0.271681	212	-0.059	0.137429	212	-0.8049	0.269244	212	42.48	68.44
782-427	294	0.63328	0.223817	294	-0.03839	0.150885	294	-0.6144	0.222571	294	38.03	212.38
783-152	495	0.71679	0.287114	495	0.07475	0.107558	495	-0.7034	0.29044	495	-33.97	108.94
784-187	227	1.18011	0.525553	227	-0.03927	0.150672	227	-1.1686	0.528235	227	82.15	188.55
785-803	189	0.51801	0.278653	189	0.07357	0.09914	189	-0.4863	0.307281	189	-78.84	102.76
786-372	244	0.46793	0.226263	244	-0.01392	0.106637	244	-0.4532	0.230663	244	-6.91	44.92
787-190	264	0.37012	0.157144	264	0.07157	0.101536	264	-0.3425	0.170274	264	-80.31	148.47
788-230	303	0.72713	0.346313	303	0.02173	0.13601	303	-0.7035	0.367258	303	22.52	113.26
789-354	148	1.32778	0.505207	148	-0.01683	0.108274	148	-1.3233	0.505046	148	187.98	349.05
790-455	129	0.73598	0.301351	129	-0.00758	0.105861	129	-0.7236	0.312756	129	24.31	160.39
791-791	169	0.64583	0.247594	169	0.08193	0.147024	169	-0.6185	0.260209	169	79.23	238.8
792-316	269	0.6036	0.285219	269	-0.0049	0.125633	269	-0.5896	0.286809	269	-99.84	230.73
793-065	199	0.44051	0.170979	199	-0.03988	0.106775	199	-0.4062	0.213162	199	-3.54	29.62
794-955	175	0.49958	0.170296	175	0.05964	0.13396	175	-0.4591	0.215733	175	78.1	227.22
795-634	260	0.48425	0.089052	260	-0.08112	0.125639	260	-0.4609	0.087681	260	0	9.51
796-010	100	1.01466	0.407931	100	0.05811	0.140996	100	-1.0003	0.415189	100	251.77	368.8
797-000	306	0.52865	0.203587	306	0.06113	0.10005	306	-0.5109	0.215058	306	-47.02	127.41
798-087	319	1.15066	0.42952	319	0.01766	0.12889	319	-1.142	0.432902	319	-6.98	193.66
799-601	314	1.29489	0.415849	314	-0.0479	0.146561	314	-1.2849	0.418324	314	9.71	205.79
800-153	365	0.56878	0.279816	365	0.03066	0.123496	365	-0.543	0.301321	365	0	0
801-420	221	1.18871	0.382548	221	-0.03295	0.131414	221	-1.179	0.388564	221	84.85	196.28
802-158	501	0.63531	0.269455	501	0.06584	0.123074	501	-0.6088	0.293628	501	-25.55	72.42
803-997	216	0.7068	0.124055	216	-0.10082	0.117917	216	-0.6895	0.124829	216	-62.63	152.19

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
804-764	160	1.50144	0.27396	160	-0.116	0.126848	160	-1.4914	0.274898	160	0	0
805-984	125	0.3164	0.136765	125	0.10265	0.13363	125	-0.2513	0.165817	125	2.53	32.65
806-914	269	1.12696	0.430934	269	-0.05494	0.099044	269	-1.1213	0.430853	269	49.41	165.38
807-888	344	1.14906	0.393193	344	-0.05468	0.115644	344	-1.1403	0.398053	344	47.61	138.18
808-557	172	0.65814	0.200203	172	-0.08517	0.122072	172	-0.6361	0.21577	172	-6.6	50.15
809-270	55	1.10163	0.453641	55	-0.00628	0.20904	55	-1.0625	0.498288	55	4.55	27.68
810-205	108	1.03538	0.299232	108	0.00663	0.136272	108	-1.025	0.304	108	197.57	263.3
811-510	501	0.40544	0.151435	501	-0.02919	0.100958	501	-0.3783	0.182129	501	-33.42	109.41
812-281	251	0.49055	0.251434	251	0.04397	0.116738	251	-0.4683	0.26281	251	-58.18	142.67
813-736	42	0.87578	0.236436	42	0.14556	0.123677	42	-0.854	0.239913	42	-65.79	152.89
814-400	233	1.07364	0.443841	233	-0.02662	0.155955	233	-1.0503	0.470873	233	112.78	291.03
815-615	120	0.44193	0.249662	120	0.06858	0.167629	120	-0.406	0.245391	120	-10.1	253.22
816-179	115	0.99948	0.295905	115	0.02219	0.145068	115	-0.9885	0.296798	115	236.07	271.02
817-082	119	0.95575	0.337835	119	0.06276	0.136683	119	-0.9438	0.338133	119	197.45	257.02
818-132	88	0.56907	0.189199	88	-0.0085	0.103991	88	-0.5591	0.190559	88	148.84	74.53
819-864	253	0.73278	0.306902	253	0.07365	0.105473	253	-0.7179	0.315223	253	-44.32	279.58
820-789	449	0.66632	0.30563	449	0.07524	0.125391	449	-0.6479	0.310224	449	-74.18	238.42
821-247	498	0.3077	0.167816	498	0.01602	0.130766	498	-0.2575	0.198042	498	12.56	99.97
822-811	7	0.33533	0.118011	7	0.01433	0.122722	7	-0.3125	0.126104	7	0	0
823-754	163	1.18596	0.607503	163	-0.03835	0.242364	163	-1.0469	0.788236	163	93.51	240.38
824-521	268	0.64738	0.352745	268	0.03151	0.125835	268	-0.607	0.398104	268	-102.08	224.64
825-102	103	1.44416	0.435732	103	-0.02768	0.119783	103	-1.4392	0.434781	103	68.03	157.77
826-697	257	0.97837	0.432751	257	-0.01539	0.130807	257	-0.9657	0.441149	257	83.09	158.5
827-337	275	0.7522	0.323352	275	0.03621	0.101275	275	-0.7432	0.326301	275	-0.01	54.37
828-845	268	0.64703	0.330865	268	0.06142	0.116101	268	-0.6313	0.33525	268	-91.24	231.86
829-129	119	0.73129	0.179947	119	-0.02916	0.102693	119	-0.7228	0.182719	119	8.29	294.61
830-533	289	0.5465	0.235711	289	0.02327	0.132587	289	-0.5259	0.244047	289	-108.25	251.37
831-109	65	0.55501	0.21384	65	-0.09704	0.079654	65	-0.5387	0.218836	65	-198.2	286.66

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
832-979	129	1.21919	0.511486	129	0.00604	0.134967	129	-1.2087	0.518721	129	169.64	353.89
833-070	416	0.41114	0.191255	416	-0.0599	0.128674	416	-0.3798	0.203113	416	-25.33	79.7
834-648	87	0.85095	0.354844	87	0.11284	0.432109	87	-0.6841	0.430638	87	-39.28	224.98
835-866	427	0.49217	0.217844	427	0.05579	0.118844	427	-0.4701	0.226858	427	22.34	146.45
836-525	145	1.30832	0.464216	145	-0.04866	0.319555	145	-1.2484	0.51502	145	171.99	309.18
837-271	329	0.76012	0.319012	329	0.00167	0.154785	329	-0.7341	0.341732	329	44.47	143.8
838-856	350	0.57296	0.296749	350	0.06525	0.223583	350	-0.5224	0.29889	350	36.1	178.36
839-213	72	0.69684	0.08469	72	0.0838	0.120637	72	-0.6815	0.082987	72	-162.28	233.53
840-339	204	0.93682	0.143525	204	-0.00085	0.138863	204	-0.9261	0.146081	204	-3.03	257.95
841-042	93	0.56447	0.206471	93	-0.08356	0.14548	93	-0.5372	0.211603	93	-72.75	158.34
842-362	183	0.27154	0.112424	183	-0.12028	0.088848	183	-0.1096	0.228624	183	-4.79	24.14
843-857	206	0.51414	0.21785	206	0.07408	0.126477	206	-0.4836	0.237757	206	-123.5	169.86
844-647	443	0.51099	0.266172	443	0.06233	0.128791	443	-0.4885	0.269957	443	10.65	71.69
845-790	164	0.53421	0.271016	164	-0.08282	0.100532	164	-0.509	0.287968	164	-34.03	70.86
846-759	269	0.60125	0.160453	269	-0.01712	0.114646	269	-0.5906	0.158224	269	8.68	94.32
847-206	363	0.52538	0.287847	363	0.04536	0.143549	363	-0.4825	0.321778	363	33.05	201.68
848-690	231	0.53737	0.253202	231	0.00736	0.129615	231	-0.4952	0.30167	231	-95.18	221.68
849-335	397	0.41121	0.190743	397	0.03487	0.130175	397	-0.3642	0.233929	397	-5.38	25.78
850-638	205	0.32212	0.196131	205	0.04109	0.12467	205	-0.2813	0.214383	205	-5.69	27.04
851-481	276	0.58949	0.311911	276	0.02216	0.120623	276	-0.573	0.318543	276	59.47	156.13
852-184	207	0.92218	0.113347	207	0.0916	0.129864	207	-0.9083	0.113926	207	-45.12	141.68
853-505	165	0.67538	0.353933	165	0.02123	0.100221	165	-0.6628	0.362868	165	-110.27	197.78
854-196	501	0.64268	0.289822	501	0.03686	0.113914	501	-0.6289	0.295324	501	-23.07	150.23
855-928	143	0.5828	0.209961	143	0.0446	0.111178	143	-0.5692	0.213403	143	24.74	173.3
856-136	236	0.46694	0.192425	236	0.08205	0.119454	236	-0.4417	0.1976	236	20.84	42.97
857-380	252	0.42775	0.196582	252	0.10826	0.113045	252	-0.3688	0.2475	252	0.95	20.21
858-856	141	1.2476	0.397884	141	-0.0408	0.144345	141	-1.2393	0.395813	141	-658.82	2190.71
859-495	41	0.84886	0.318333	41	0.02619	0.145267	41	-0.8211	0.356445	41	164.98	175.33

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
860-973	179	0.47472	0.10781	179	0.01622	0.141412	179	-0.4503	0.118613	179	19.65	49.56
861-011	87	0.72004	0.319889	87	0.07457	0.142568	87	-0.6962	0.332388	87	31.89	127.68
862-449	32	0.74518	0.223634	32	-0.01555	0.077543	32	-0.741	0.223802	32	0	0
863-459	138	0.52003	0.10636	138	0.03848	0.106931	138	-0.5035	0.124209	138	12.64	55.46
864-989	115	0.37928	0.098875	115	0.05198	0.110417	115	-0.3521	0.122245	115	21.25	116.65
865-020	145	1.03304	0.318424	145	0.02317	0.154337	145	-1.0205	0.320723	145	80.74	304.28
866-059	102	0.40814	0.168531	102	0.05711	0.099054	102	-0.3887	0.175945	102	109.04	220.47
867-458	253	0.59921	0.292571	253	0.06486	0.095518	253	-0.5856	0.29733	253	-80.47	203.26
868-345	206	0.67398	0.358498	206	-0.01623	0.131911	206	-0.6598	0.360335	206	7.28	282.49
869-209	36	0.56397	0.197538	36	-0.19019	0.176014	36	-0.5073	0.182493	36	-234.39	198.87
870-882	169	0.71677	0.288112	169	0.05302	0.107538	169	-0.7049	0.292547	169	-83.57	181.26
871-772	112	0.35403	0.186905	112	-0.03439	0.079328	112	-0.3305	0.209112	112	11.83	57.14
872-937	312	0.47792	0.288851	312	-0.00029	0.112145	312	-0.4559	0.302527	312	-10.74	52.99
873-799	73	0.68012	0.235384	73	-0.0776	0.075595	73	-0.6614	0.26274	73	-200.41	297.51
874-072	92	0.59064	0.167157	92	0.10409	0.156088	92	-0.5571	0.177605	92	8.33	41.67
875-462	428	0.37874	0.172516	428	0.07623	0.111888	428	-0.3479	0.184128	428	-37.17	109.6
876-490	116	0.40433	0.112008	116	-0.06448	0.085197	116	-0.3887	0.116759	116	-78.27	109.17
877-062	109	0.92004	0.283482	109	-0.0675	0.184622	109	-0.889	0.313522	109	-0.39	16.27
878-137	112	0.57323	0.094655	112	-0.15457	0.095043	112	-0.5447	0.089412	112	1.12	16.91
879-378	47	0.44296	0.177321	47	0.07991	0.141511	47	-0.4115	0.179861	47	-141.28	144.69
880-649	113	0.96643	0.467327	113	-0.00874	0.384824	113	-0.8247	0.571245	113	123.01	269.74
881-130	495	0.64007	0.27958	495	0.07724	0.124226	495	-0.6213	0.283645	495	-18.41	74.8
882-353	287	1.12784	0.418991	287	-0.02774	0.131637	287	-1.1188	0.421803	287	56.38	131.12
883-915	172	0.28724	0.154309	172	0.06043	0.104644	172	-0.2489	0.172838	172	-1.08	134
884-972	488	0.63914	0.282617	488	0.07257	0.112266	488	-0.6197	0.294062	488	-14.16	70.84
885-618	230	0.45927	0.218066	230	0.12849	0.150323	230	-0.3981	0.247006	230	-6.67	34.06
886-960	100	0.62286	0.231585	100	0.06296	0.130556	100	-0.6053	0.233033	100	145.1	184.92
887-237	119	0.82063	0.299597	119	0.05283	0.120434	119	-0.8086	0.303794	119	90.61	198.95

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
888-679	260	0.68108	0.24872	260	-0.06349	0.099486	260	-0.67	0.250971	260	13.36	85.26
889-111	230	0.49087	0.152	230	-0.1289	0.120393	230	-0.4551	0.161023	230	15.75	83.42
890-903	142	0.73114	0.264727	142	0.00311	0.117924	142	-0.715	0.282178	142	49.63	133.81
891-636	227	0.57233	0.266741	227	0.00349	0.125265	227	-0.554	0.275968	227	-1.45	38.1
892-417	279	1.19708	0.409384	279	0.00763	0.10821	279	-1.1916	0.411097	279	54.95	153.4
893-201	133	0.89543	0.261048	133	-0.08902	0.15675	133	-0.8729	0.275168	133	-14.59	73.74
894-700	109	0.57628	0.241375	109	0.01455	0.115342	109	-0.5626	0.24596	109	-232.76	341.72
895-437	501	0.61084	0.2511	501	0.04322	0.120565	501	-0.5945	0.257752	501	-25.76	107.92
896-034	222	0.91787	0.402139	222	0.04096	0.115263	222	-0.9063	0.409775	222	48.63	172.27
897-148	431	0.51158	0.242555	431	0.06292	0.108927	431	-0.4935	0.247317	431	-13.29	79.68
898-003	396	0.50808	0.298033	396	0.06161	0.132192	396	-0.4868	0.297941	396	65.07	213.03
899-682	181	1.02507	0.39694	181	-0.07501	0.115301	181	-1.0152	0.398588	181	0.29	89.15
900-467	145	1.35513	0.491203	145	-0.01585	0.201328	145	-1.3389	0.494424	145	220.17	267.25
901-054	284	1.43398	0.504222	284	-0.02443	0.153593	284	-1.4255	0.504494	284	60.94	249.11
902-473	213	1.09476	0.434205	213	-0.10736	0.122437	213	-1.0806	0.439155	213	69.03	163.13
903-078	215	1.20031	0.418736	215	-0.07309	0.125059	215	-1.1913	0.419454	215	50.57	256.98
904-467	301	1.25376	0.525397	301	-0.05394	0.1371	301	-1.2427	0.531192	301	80.65	233.07
905-733	69	0.84109	0.372083	69	0.03719	0.140357	69	-0.8284	0.37251	69	225.52	205.84
906-140	115	0.71223	0.333183	115	-0.06493	0.12977	115	-0.6932	0.341856	115	-36.83	236.02
907-282	206	0.74431	0.240492	206	0.05095	0.116689	206	-0.7322	0.243968	206	44.98	130.98
908-015	104	1.10722	0.153444	104	0.08757	0.157683	104	-1.0927	0.152621	104	-100.82	229.04
909-438	81	0.41317	0.196967	81	-0.01179	0.114082	81	-0.3865	0.217227	81	-40.48	98.99
910-304	337	1.11062	0.373996	337	-0.05063	0.115448	337	-1.1018	0.378899	337	0.04	22.09
911-216	455	0.53357	0.274698	455	0.03525	0.115552	455	-0.5113	0.290171	455	-76.49	179.64
912-450	238	0.72677	0.354068	238	-0.03098	0.095349	238	-0.6932	0.404011	238	10.91	59.32
913-787	154	0.60597	0.300733	154	0.02991	0.090464	154	-0.5952	0.307165	154	-165.87	298.17
914-563	170	0.64466	0.318817	170	0.04186	0.115026	170	-0.6231	0.337883	170	30.82	237.55
915-830	296	0.63388	0.291	296	0.06952	0.120536	296	-0.5831	0.356779	296	-5.01	35.22

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
916-508	189	1.30034	0.446369	189	-0.04024	0.108846	189	-1.2948	0.447551	189	3.13	28.47
917-701	453	0.64926	0.249228	453	-0.08262	0.115426	453	-0.6325	0.252002	453	-30.71	84.47
918-389	388	0.43654	0.094274	388	-0.04	0.097612	388	-0.4218	0.102122	388	11.62	65.5
919-758	322	0.43149	0.241242	322	0.01963	0.121465	322	-0.4077	0.251129	322	58.54	208.41
920-003	95	0.90522	0.323328	95	0.02027	0.200977	95	-0.8747	0.344544	95	128.4	243.12
921-314	115	0.64568	0.259308	115	-0.05748	0.115193	115	-0.6335	0.25766	115	-75.01	156.62
922-893	261	0.48236	0.1518	261	0.04768	0.092823	261	-0.4676	0.161812	261	17.7	71.9
923-765	191	0.76107	0.226943	191	-0.0402	0.101907	191	-0.7523	0.230043	191	-13.46	208.92
924-705	120	0.72684	0.213908	120	0.08032	0.122674	120	-0.7109	0.217491	120	65.75	123.54
925-561	140	1.33362	0.424108	140	-0.03219	0.146319	140	-1.3248	0.425318	140	213.91	324.12
926-966	29	0.98297	0.336099	29	0.04477	0.293421	29	-0.9273	0.367295	29	0	0
927-410	251	0.56942	0.299464	251	0.01929	0.118761	251	-0.545	0.320197	251	0	0
928-094	78	1.07593	0.52969	78	-0.09836	0.559435	78	-0.8871	0.577393	78	9.32	59.26
929-875	94	0.4984	0.212884	94	-0.01976	0.133093	94	-0.4715	0.231527	94	-162.51	185.77
930-019	160	0.79324	0.311315	160	0.05812	0.138878	160	-0.7779	0.313806	160	-103.14	168.42
931-846	166	0.4081	0.162337	166	0.01114	0.106132	166	-0.3928	0.165304	166	-47.71	103.03
932-961	212	0.63135	0.269537	212	0.05396	0.100323	212	-0.6195	0.27311	212	-4.43	211.77
933-805	343	0.56758	0.276086	343	0.00767	0.121142	343	-0.5418	0.300274	343	-4.57	27.14
934-908	400	0.38578	0.224083	400	-0.00098	0.115129	400	-0.3565	0.242409	400	-0.01	0.85
935-860	7	1.64379	0.067052	7	-0.13054	0.091637	7	-1.6363	0.069819	7	183.43	230.54
936-652	197	0.49404	0.278287	197	-0.04047	0.088285	197	-0.4687	0.304159	197	9.38	77.37
937-360	323	1.17133	0.429996	323	-0.01949	0.132525	323	-1.1621	0.434268	323	54.17	184.91
938-165	103	0.65801	0.105191	103	-0.04847	0.086233	103	-0.6505	0.10577	103	14.39	65.96
939-936	150	1.37425	0.426978	150	-0.05668	0.140469	150	-1.3649	0.430156	150	195.45	261.37
940-171	96	0.95416	0.144387	96	0.00249	0.144899	96	-0.9423	0.150297	96	-207.21	265.15
941-750	245	0.53223	0.280765	245	0.05692	0.116642	245	-0.5088	0.294103	245	-103.73	177.45
942-134	131	0.83981	0.23898	131	0.00801	0.123964	131	-0.8282	0.247372	131	82.31	146.38
943-363	264	0.64608	0.327917	264	0.01367	0.113798	264	-0.6256	0.347152	264	0	0

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
944-919	252	0.47816	0.262266	252	0.01459	0.094878	252	-0.4431	0.303379	252	0	0
945-124	392	1.04064	0.420019	392	-0.01878	0.150092	392	-1.0279	0.424198	392	43.52	155.41
946-413	338	1.18172	0.449855	338	-0.0431	0.12041	338	-1.1741	0.451793	338	59.82	184.74
947-437	276	1.24778	0.407943	276	-0.03777	0.104597	276	-1.2424	0.409217	276	51.6	208.45
948-806	336	1.21793	0.454118	336	-0.08441	0.125446	336	-1.2068	0.458701	336	28.66	176.58
949-747	250	1.02218	0.412423	250	-0.0228	0.099584	250	-1.0143	0.419306	250	38.24	236.74
950-745	312	1.02511	0.438327	312	-0.10015	0.114371	312	-1.011	0.444732	312	98.63	227.78
951-439	462	0.62588	0.275869	462	0.01822	0.11905	462	-0.6121	0.280589	462	-56.18	170.43
952-432	245	1.04418	0.472555	245	-0.05612	0.116795	245	-1.0311	0.483391	245	53.9	185.19
953-026	339	1.16705	0.4711422	339	-0.03547	0.130094	339	-1.1574	0.476021	339	65.03	218.98
954-209	310	1.23852	0.516775	310	-0.05971	0.144035	310	-1.2247	0.526266	310	91.32	245.78
955-531	433	0.6482	0.290414	433	0.01606	0.118603	433	-0.6343	0.296348	433	-67.22	187.01
956-553	135	0.58432	0.162019	135	-0.11897	0.125175	135	-0.5573	0.165455	135	49.01	111.34
957-631	52	1.09124	0.286604	52	-0.03334	0.169443	52	-1.0756	0.294828	52	138.31	236.25
958-153	100	0.91647	0.377781	100	0.03209	0.135004	100	-0.9038	0.383034	100	113.56	239.75
959-415	97	1.06962	0.396406	97	0.11829	0.196241	97	-1.0419	0.404405	97	208.15	349.86
960-627	194	0.82727	0.299503	194	0.04799	0.138425	194	-0.8144	0.299257	194	64.44	166.52
961-481	201	1.0845	0.310125	201	-0.0093	0.124777	201	-1.0774	0.309638	201	30.02	131.88
962-716	69	0.52573	0.275112	69	-0.01142	0.151844	69	-0.3721	0.438681	69	-10.87	64.67
963-909	139	1.16602	0.466819	139	0.00596	0.153443	139	-1.1501	0.481086	139	171.78	338.54
964-802	91	0.7051	0.286477	91	-0.08584	0.126137	91	-0.6845	0.296171	91	-128.11	194.9
965-067	185	1.05752	0.42749	185	0.03952	0.150362	185	-1.0389	0.444886	185	84.46	213.01
966-007	36	0.56158	0.295295	36	-0.01006	0.175199	36	-0.452	0.413118	36	129.14	245.9
967-829	95	0.98171	0.423867	95	0.04694	0.114541	95	-0.9715	0.429555	95	153.07	291.31
968-146	70	1.24027	0.271237	70	-0.03702	0.150179	70	-1.2311	0.269339	70	0	0
969-640	108	0.68264	0.31946	108	-0.08128	0.104656	108	-0.662	0.335292	108	-89.76	176.42
970-549	96	1.04267	0.333039	96	0.05398	0.141671	96	-1.032	0.331923	96	163.92	223.96
971-558	107	1.16127	0.387804	107	0.05303	0.127039	107	-1.1522	0.390567	107	189.72	319.08

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
972-641	84	0.62897	0.259797	84	-0.11232	0.100485	84	-0.6085	0.265123	84	-149.21	192.19
973-711	125	0.97035	0.318279	125	0.04547	0.143756	125	-0.9548	0.329774	125	165.38	290.76
974-393	177	1.33376	0.492024	177	-0.04449	0.133649	177	-1.3239	0.498591	177	3.95	34
975-902	106	0.62978	0.25439	106	-0.07284	0.108078	106	-0.6112	0.266303	106	-154.71	197.09
976-055	122	1.13024	0.297347	122	0.03199	0.130497	122	-1.1215	0.300291	122	108.07	260.77
977-858	152	1.40312	0.468919	152	-0.0107	0.152066	152	-1.3921	0.477064	152	134.29	296.38
978-078	307	0.97073	0.345482	307	-0.04613	0.105573	307	-0.9631	0.347734	307	0	0
979-598	174	1.12637	0.382404	174	0.04026	0.195294	174	-1.0978	0.412736	174	151.56	314.45
980-216	5	0.23708	0.09267	5	-0.0609	0.14075	5	-0.1942	0.085236	5	-165	250.96
981-254	332	1.19592	0.44924	332	-0.0953	0.118329	332	-1.1841	0.454764	332	31.63	141.77
982-229	339	1.1305	0.410116	339	-0.0445	0.150619	339	-1.1186	0.412861	339	23.75	132.89
983-394	272	0.61682	0.292055	272	0.09443	0.141904	272	-0.5826	0.31212	272	-57.51	123.58
984-357	94	0.83845	0.328295	94	0.03599	0.158927	94	-0.824	0.324745	94	182.68	328.23
985-268	272	1.1633	0.447318	272	-0.03226	0.134021	272	-1.1519	0.4557	272	68.08	228.8
986-141	207	0.55669	0.268805	207	0.0631	0.098524	207	-0.5348	0.287226	207	-26.3	71.74
987-261	256	1.18308	0.513971	256	-0.03394	0.12215	256	-1.1748	0.517418	256	65.46	157.6
988-626	152	1.31128	0.435157	152	-0.04017	0.136362	152	-1.3026	0.438084	152	163.05	343.9
989-544	327	0.59866	0.192583	327	-0.08695	0.129721	327	-0.5715	0.211037	327	25.05	151.68
990-163	184	0.57685	0.240219	184	0.08658	0.11518	184	-0.5565	0.245053	184	21.76	203.28
991-507	161	1.27554	0.415471	161	-0.0209	0.16606	161	-1.2638	0.41794	161	42.12	169.06
992-405	284	0.48569	0.261544	284	-0.0294	0.107738	284	-0.4624	0.279461	284	-3.58	112.13
993-407	141	0.37403	0.13675	141	-0.03023	0.115816	141	-0.3542	0.137508	141	-66.33	118.65
994-197	139	0.84024	0.272705	139	-0.08632	0.110692	139	-0.8286	0.272395	139	7.07	35.7
995-225	189	0.79874	0.277991	189	-0.05303	0.138769	189	-0.7767	0.300179	189	34.92	122.66
996-927	125	1.10917	0.354906	125	0.0158	0.133286	125	-1.1006	0.356495	125	147.51	225.89
997-928	501	0.48208	0.134807	501	0.02224	0.124756	501	-0.4624	0.143919	501	-0.09	14.56
998-536	199	0.19768	0.141966	199	-0.01709	0.116907	199	-0.1191	0.176696	199	7.7	59.08
999-644	302	0.69371	0.274236	302	0.07094	0.108412	302	-0.6758	0.288036	302	-41.89	125.88

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
1000-072	162	1.27145	0.282174	162	-0.08422	0.159486	162	-1.2579	0.285646	162	74.92	207.39
1001-379	230	1.14989	0.158351	230	0.0739	0.120255	230	-1.1413	0.157768	230	-22.74	117.75
1002-371	186	1.36623	0.480331	186	-0.01454	0.118127	186	-1.3606	0.481781	186	7.53	54.06
1003-048	367	0.74402	0.181883	367	0.07417	0.142361	367	-0.7253	0.186709	367	26.28	174.87
1004-924	185	0.24027	0.198389	185	0.04053	0.102409	185	-0.1671	0.239148	185	-0.75	53.96
1005-279	139	0.49194	0.212933	139	0.03636	0.13573	139	-0.4618	0.233618	139	-15.4	209.4
1006-275	95	0.81144	0.241771	95	-0.13118	0.102041	95	-0.7904	0.254515	95	166.47	278.28
1007-663	169	0.60725	0.192014	169	-0.02337	0.092789	169	-0.5986	0.195374	169	-62.62	138.56
1008-891	126	0.39729	0.18436	126	-0.01923	0.15147	126	-0.3444	0.224042	126	21.25	203.76
1009-204	175	0.59686	0.229732	175	0.04745	0.104321	175	-0.5803	0.24333	175	31.03	144.07
1010-194	123	0.73241	0.225584	123	0.01961	0.123791	123	-0.722	0.224681	123	22.1	171.5
1011-763	105	0.40845	0.161552	105	-0.11819	0.092717	105	-0.381	0.158961	105	-57.75	94.75
1012-463	467	0.32653	0.174647	467	-0.0478	0.114417	467	-0.2987	0.180352	467	1.5	91.04
1013-436	501	0.66739	0.282866	501	0.07551	0.114677	501	-0.651	0.287658	501	-0.46	23.82
1014-504	428	0.46573	0.198901	428	0.0411	0.102139	428	-0.4488	0.207159	428	19.14	53.53
1015-761	405	0.38654	0.124391	405	-0.01995	0.113833	405	-0.3498	0.17099	405	2	65.4
1016-541	272	1.30221	0.385873	272	0.03545	0.12089	272	-1.2954	0.388373	272	-12.57	61.43
1017-500	231	0.64767	0.323663	231	-0.03563	0.090244	231	-0.6357	0.332741	231	-9.37	41.32
1018-611	146	0.64483	0.245058	146	-0.0079	0.138177	146	-0.6224	0.263655	146	24.88	80.02
1019-632	186	0.62161	0.297213	186	0.00918	0.11852	186	-0.6063	0.305218	186	-86.95	203.16
1020-876	501	0.336	0.123021	501	0.05971	0.101051	501	-0.3095	0.135863	501	-2.86	27.33
1021-308	121	0.63912	0.212857	121	0.02827	0.147598	121	-0.6181	0.222165	121	79.99	143.62
1022-536	290	0.67563	0.27348	290	-0.0556	0.127881	290	-0.6509	0.296998	290	12.99	143.03
1023-872	501	0.60592	0.252897	501	0.05274	0.12585	501	-0.5858	0.263264	501	10.91	55.12
1024-218	135	0.54777	0.235579	135	0.11827	0.099141	135	-0.4733	0.328896	135	63.5	167.7
1025-516	218	1.20015	0.455183	218	0.02492	0.145299	218	-1.1857	0.469129	218	80.17	189.14
1026-241	191	0.43259	0.193261	191	0.01646	0.121691	191	-0.4101	0.203355	191	6.98	45.52
1027-934	112	0.42393	0.182129	112	0.00278	0.163474	112	-0.3972	0.169116	112	4.15	22.35

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
1028-760	221	0.4167	0.162917	221	-0.03109	0.163285	221	-0.3786	0.171197	221	-6.11	47.03
1029-422	114	0.33765	0.133069	114	-0.11325	0.097439	114	-0.2865	0.165817	114	-16.21	68.56
1030-147	14	0.36988	0.06698	14	-0.07553	0.03561	14	-0.3604	0.067086	14	-221.57	206.68
1031-948	135	0.43551	0.14916	135	-0.02285	0.087875	135	-0.3942	0.220381	135	-0.03	15.88
1032-898	54	0.35349	0.114767	54	0.11932	0.059796	54	-0.3239	0.124549	54	5.31	45.67
1033-681	255	1.01217	0.364005	255	0.04543	0.139523	255	-1.0005	0.366681	255	-4.78	25.98
1034-338	297	0.62936	0.284833	297	0.01332	0.115709	297	-0.6168	0.288477	297	-18.15	206.23
1035-377	150	0.88942	0.398114	150	0.10722	0.181402	150	-0.8579	0.411564	150	-37.02	247.64
1036-700	201	1.01435	0.141892	201	0.08121	0.124285	201	-1.0038	0.139635	201	-14.02	74.69
1037-972	123	1.66601	0.487609	123	-0.01052	0.144156	123	-1.6595	0.488572	123	0	0
1038-942	212	1.07321	0.16252	212	0.09602	0.120353	212	-1.0624	0.160668	212	-0.03	25.54
1039-863	166	1.52724	0.144353	166	-0.09273	0.107806	166	-1.5205	0.146158	166	0	22.7
1040-119	366	1.00932	0.402464	366	-0.04315	0.203017	366	-0.9721	0.439215	366	-3.1	69.78
1041-097	133	0.47165	0.106572	133	0.11861	0.094916	133	-0.3447	0.304266	133	-3.64	24.36
1042-922	199	1.35412	0.43798	199	-0.06066	0.116045	199	-1.3464	0.44213	199	8.28	75.81
1043-798	111	1.56967	0.148894	111	-0.09232	0.12371	111	-1.5618	0.151693	111	-0.02	20.92
1044-614	148	0.89326	0.37956	148	-0.06219	0.134565	148	-0.8765	0.389801	148	-64.46	232.9
1045-400	73	0.56272	0.132327	73	-0.10078	0.145727	73	-0.5311	0.145146	73	-30.04	175.59
1046-786	381	0.60629	0.290357	381	0.04036	0.123545	381	-0.5906	0.293627	381	7.02	47.69
1047-162	342	0.61855	0.309194	342	0.06459	0.128294	342	-0.5986	0.315112	342	2.01	94.53
1048-897	29	0.49231	0.174408	29	0.14118	0.189443	29	-0.4014	0.240837	29	0	0
1049-905	393	0.51174	0.257291	393	0.06061	0.124874	393	-0.489	0.264068	393	0	0
1050-073	180	1.28642	0.519824	180	-0.01923	0.147058	180	-1.2775	0.520674	180	107.87	211.54
1051-484	205	0.73387	0.267512	205	-0.02599	0.103969	205	-0.7231	0.275512	205	-60.37	161.97
1052-721	240	0.61077	0.32436	240	0.0302	0.142721	240	-0.574	0.357311	240	-2.66	99.73
1053-048	174	1.30138	0.510169	174	0.00571	0.136896	174	-1.2939	0.510827	174	128.77	277.44
1054-364	277	1.23165	0.488557	277	-0.00521	0.150453	277	-1.2204	0.493685	277	55.71	187.41
1055-784	286	1.29791	0.462608	286	-0.06749	0.12907	286	-1.2884	0.466316	286	56.88	189.01

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
1056-711	111	0.64006	0.279891	111	0.07148	0.102427	111	-0.6262	0.283621	111	-83.59	253.8
1057-530	501	0.6345	0.254829	501	0.05307	0.118513	501	-0.6191	0.259719	501	-22.36	119.54
1058-217	220	0.9137	0.395151	220	-0.0293	0.134087	220	-0.9015	0.399388	220	7.45	248.35
1059-559	97	1.00629	0.393161	97	0.0562	0.10288	97	-0.9984	0.396027	97	126.49	251.13
1060-682	239	1.18873	0.467484	239	-0.01448	0.099116	239	-1.1835	0.470111	239	59.46	169.15
1061-819	314	1.29659	0.446406	314	-0.00302	0.121375	314	-1.2899	0.449247	314	19.79	104.21
1062-423	260	0.59822	0.270487	260	0.07108	0.140867	260	-0.5463	0.328478	260	-35.9	134.29
1063-497	305	1.31238	0.478719	305	-0.06599	0.122076	305	-1.3041	0.481156	305	22.75	124.05
1064-214	197	0.83405	0.299732	197	-0.00096	0.131113	197	-0.8221	0.304267	197	-32.07	208.76
1065-700	164	1.29964	0.552755	164	-0.00104	0.138713	164	-1.2918	0.553777	164	121.14	260.26
1066-382	362	0.64732	0.294729	362	-0.00381	0.124257	362	-0.6329	0.299942	362	-31.17	258.01
1067-930	127	0.7347	0.285946	127	0.01037	0.133411	127	-0.7179	0.29747	127	-224.21	309.12
1068-172	201	1.1726	0.426426	201	-0.00564	0.139902	201	-1.1591	0.440354	201	54.95	154.29
1069-147	88	0.99076	0.416444	88	0.05854	0.103833	88	-0.9806	0.423531	88	115.33	233.45
1070-607	105	0.58584	0.257281	105	-0.10144	0.088018	105	-0.5601	0.279021	105	-86.42	185.58
1071-077	257	1.12044	0.481366	257	-0.05198	0.126209	257	-1.1104	0.485352	257	66.25	182.38
1072-277	78	0.82475	0.354177	78	0.05691	0.119231	78	-0.8134	0.356029	78	182.96	274.59
1073-103	225	0.72242	0.416842	225	0.01903	0.278804	225	-0.5982	0.51032	225	53.74	137.66
1074-277	106	0.9725	0.382997	106	0.0474	0.1373	106	-0.9606	0.385818	106	130.24	220.07
1075-800	328	1.25728	0.449376	328	-0.02348	0.126152	328	-1.2506	0.449794	328	0	0
1076-122	103	0.60773	0.247687	103	-0.07831	0.13625	103	-0.572	0.281405	103	-154.4	202.2
1077-962	119	1.33175	0.507684	119	0.01043	0.198792	119	-1.3135	0.516436	119	218.06	357.52
1078-010	137	0.36076	0.228401	137	-0.04139	0.115397	137	-0.3303	0.241477	137	0	0
1079-461	437	0.66282	0.305197	437	0.03161	0.112431	437	-0.6508	0.308811	437	-72.27	216.81
1080-136	501	0.63569	0.248072	501	0.06442	0.12292	501	-0.6178	0.254339	501	-18.39	98.46
1081-159	261	0.52051	0.275672	261	0.00038	0.10247	261	-0.5043	0.286694	261	0	0
1082-330	285	1.26082	0.44959	285	-0.03601	0.14038	285	-1.2438	0.47325	285	103.39	268.71
1083-052	2	1.4296	0.36812	2	-0.3241	0.170696	2	-1.3909	0.338563	2	-229.5	324.56

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
1084-506	284	0.65604	0.271049	284	0.04016	0.136046	284	-0.6279	0.299266	284	-52.36	147.77
1085-206	323	1.29345	0.466571	323	-0.02758	0.11158	323	-1.2873	0.469337	323	42.57	171.55
1086-730	141	1.28856	0.545455	141	0.00249	0.106929	141	-1.2838	0.546311	141	105.57	225.91
1087-878	91	1.42368	0.427746	91	-0.00194	0.126118	91	-1.4169	0.431786	91	0	0
1088-801	2	0.06425	0.017041	2	0.0048	0.065761	2	-0.0273	0.051831	2	0	0
1089-489	97	0.51179	0.297671	97	-0.08184	0.126317	97	-0.4253	0.384375	97	-128.02	175.69
1090-807	375	0.58856	0.28169	375	0.0622	0.123539	375	-0.5707	0.284594	375	14.06	145.66
1091-916	111	0.98409	0.395977	111	-0.01473	0.112287	111	-0.9741	0.40463	111	-137.13	209.07
1092-661	234	0.52326	0.27253	234	0.02192	0.110392	234	-0.5062	0.281452	234	0	0
1093-402	338	1.08671	0.490583	338	-0.06287	0.126483	338	-1.0747	0.496658	338	101.78	225.82
1094-487	95	0.93953	0.560508	95	-0.04567	0.423786	95	-0.6982	0.729334	95	82.76	183.77
1095-913	227	0.61208	0.332352	227	-0.01443	0.12811	227	-0.569	0.380772	227	-108.3	221.66
1096-221	277	0.60672	0.275797	277	0.01944	0.128526	277	-0.5509	0.352204	277	-87.37	199.16
1097-567	324	1.19232	0.516142	324	-0.07636	0.134518	324	-1.18	0.521292	324	81.33	227.8
1098-857	307	1.29359	0.458012	307	-0.04304	0.122477	307	-1.286	0.461149	307	36.74	168.17
1099-900	50	0.96391	0.174107	50	0.05885	0.096036	50	-0.9569	0.17715	50	63	181.21
1100-519	255	1.18785	0.494581	255	0.01024	0.281409	255	-1.1094	0.588463	255	54.79	143.46
1101-561	360	1.23291	0.44236	360	-0.02001	0.175766	360	-1.2189	0.445964	360	0	0
1102-075	164	1.34112	0.524638	164	0.01018	0.139987	164	-1.3336	0.525252	164	129.71	241.92
1103-852	270	1.12793	0.473934	270	-0.00844	0.183019	270	-1.1063	0.489376	270	47.97	154.67
1104-793	301	1.10509	0.418967	301	-0.01498	0.102692	301	-1.0977	0.42546	301	45.78	198.57
1105-842	256	1.25675	0.480795	256	-0.02608	0.121833	256	-1.2506	0.480644	256	82.88	197.32
1106-313	335	1.24914	0.450901	335	-0.0135	0.145515	335	-1.2394	0.454161	335	42.43	195.67
1107-886	170	1.32384	0.374395	170	-0.05413	0.138511	170	-1.3159	0.373019	170	187.68	222.67
1108-957	177	1.11019	0.424929	177	-0.0385	0.144119	177	-1.0991	0.4277	177	121.73	237.81
1109-302	441	0.75471	0.316715	441	0.08103	0.133805	441	-0.736	0.322168	441	-36.73	138.93
1110-944	89	0.54391	0.237191	89	-0.0788	0.086924	89	-0.5122	0.27614	89	-55.98	89.34
1111-927	279	0.70705	0.210274	279	-0.03847	0.107479	279	-0.6947	0.22051	279	38.56	122.37

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
1112-583	156	0.6851	0.178947	156	0.01353	0.145691	156	-0.6686	0.181889	156	56.71	109.39
1113-956	73	0.57753	0.178444	73	0.02018	0.111033	73	-0.5655	0.181674	73	1.05	10.65
1114-193	157	0.77365	0.170788	157	0.03673	0.136247	157	-0.7597	0.175635	157	63.42	116.45
1115-120	109	0.67876	0.21142	109	-0.00957	0.109356	109	-0.6558	0.252276	109	39.72	98.92
1116-701	113	1.35472	0.526068	113	0.0029	0.130188	113	-1.3395	0.548837	113	0	0
1117-741	69	0.55655	0.190908	69	0.08271	0.075181	69	-0.5433	0.196613	69	-90.45	145.45
1118-931	155	0.58971	0.16801	155	0.08567	0.113063	155	-0.5729	0.166603	155	58.76	160.62
1119-361	493	0.66646	0.29291	493	0.09421	0.110592	493	-0.6501	0.293673	493	-22.57	100.14
1120-175	374	0.63182	0.276649	374	0.07148	0.130282	374	-0.5955	0.314921	374	-26.08	106.51
1121-686	128	0.99511	0.312964	128	-0.03349	0.158357	128	-0.9782	0.324619	128	-272.57	418.21
1122-015	127	1.03424	0.360536	127	0.011	0.13184	127	-1.0243	0.364753	127	69.34	219.83
1123-986	78	1.18426	0.442582	78	-0.02438	0.172977	78	-1.1707	0.444503	78	56.6	224.3
1124-235	335	0.62649	0.267663	335	0.03832	0.127888	335	-0.5937	0.306585	335	0	0
1125-457	186	1.1173	0.513691	186	-0.05966	0.152027	186	-1.1018	0.521226	186	87.96	162.2
1126-993	300	0.70749	0.342726	300	0.02745	0.12502	300	-0.6918	0.35093	300	-78.77	175.37
1127-224	258	1.34015	0.498174	258	-0.07276	0.123502	258	-1.3322	0.49882	258	18.81	72.82
1128-621	273	1.3533	0.456794	273	-0.04479	0.122997	273	-1.3467	0.457476	273	13.65	91.09
1129-395	396	0.64394	0.295732	396	0.03246	0.129755	396	-0.6055	0.343115	396	2.31	30.02
1130-820	310	0.68855	0.294942	310	0.0333	0.138864	310	-0.6729	0.296525	310	-8.53	47.87
1131-968	283	1.0402	0.501249	283	-0.03641	0.155209	283	-1.0265	0.504192	283	51.91	115.82
1132-429	279	1.20397	0.475662	279	-0.03435	0.114851	279	-1.1961	0.480403	279	92.9	193.56
1133-133	105	0.39423	0.206357	105	-0.01262	0.14659	105	-0.3649	0.208317	105	0	0
1134-207	246	1.13357	0.442615	246	-0.02026	0.102269	246	-1.1279	0.444846	246	64.63	117.62
1135-123	321	1.15489	0.497831	321	-0.02828	0.173753	321	-1.1395	0.502288	321	74.3	164.48
1136-858	249	1.12421	0.439728	249	0.00426	0.144117	249	-1.1137	0.442832	249	61.15	123.39
1137-849	136	0.9685	0.281909	136	-0.01736	0.138768	136	-0.9565	0.288453	136	-115.71	227.67
1138-588	240	1.1169	0.472196	240	-0.00871	0.117664	240	-1.1095	0.474876	240	85.12	164.6
1139-809	364	0.60286	0.299714	364	0.03815	0.123364	364	-0.5822	0.312525	364	-24.7	77.47

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
1140-674	90	0.62028	0.246101	90	-0.13721	0.108754	90	-0.5872	0.264845	90	-58.56	112.38
1141-720	361	0.55362	0.290835	361	0.07095	0.103364	361	-0.5302	0.30706	361	-30.08	74.94
1142-459	360	0.65658	0.310391	360	0.03622	0.128924	360	-0.632	0.331921	360	5.69	53.26
1143-688	237	1.25893	0.445355	237	-0.04102	0.099129	237	-1.2535	0.447694	237	87.07	182.83
1144-142	247	0.74203	0.290583	247	0.08938	0.104763	247	-0.7243	0.302533	247	-100.79	208.43
1145-416	231	0.92654	0.204396	231	0.10482	0.128448	231	-0.9105	0.209463	231	2.32	43.86
1146-815	165	1.16774	0.437498	165	-0.05534	0.117425	165	-1.1605	0.437679	165	153.48	218.82
1147-824	189	1.18624	0.491061	189	-0.07943	0.105594	189	-1.1768	0.49617	189	32.34	93.63
1148-604	405	0.89337	0.399577	405	-0.0067	0.175497	405	-0.8733	0.405316	405	28.5	94.36
1149-543	269	1.13036	0.436546	269	-0.00688	0.129657	269	-1.1218	0.439311	269	45.75	117.42
1150-412	234	0.83937	0.335924	234	-0.03545	0.140014	234	-0.8258	0.338683	234	10.35	246.01
1151-355	32	0.26751	0.088494	32	-0.05377	0.129388	32	-0.2219	0.105602	32	-113.28	56.02
1152-114	231	0.65497	0.362838	231	0.05928	0.13838	231	-0.6307	0.374616	231	51	170.42
1153-038	324	0.60463	0.263048	324	0.07023	0.141816	324	-0.5753	0.2807	324	-21.41	75.09
1154-116	358	0.52134	0.254943	358	0.05619	0.136957	358	-0.499	0.256805	358	-3.51	36.99
1155-471	215	1.14888	0.413035	215	-0.08872	0.113785	215	-1.1398	0.413046	215	0	0
1156-173	329	1.17405	0.447337	329	-0.0732	0.115891	329	-1.1652	0.449506	329	-0.01	0.94
1157-377	349	1.12712	0.434818	349	-0.08551	0.13667	349	-1.1148	0.436813	349	0	0
1158-393	106	0.96014	0.348185	106	0.02762	0.129559	106	-0.9491	0.353591	106	115.83	199.55
1159-197	151	1.03298	0.423901	151	0.03008	0.106635	151	-1.0256	0.427401	151	161.94	243.58
1160-036	79	0.74384	0.297646	79	-0.03383	0.07614	79	-0.7221	0.337606	79	-225.11	251.85
1161-758	174	1.15286	0.406917	174	-0.01001	0.107347	174	-1.1459	0.412437	174	70.1	204.24
1162-636	245	1.12429	0.459419	245	-0.03409	0.140127	245	-1.1124	0.465762	245	102.4	267.25
1163-380	160	1.23224	0.412866	160	-0.01917	0.192381	160	-1.2124	0.426485	160	148.6	311.31
1164-960	261	1.05632	0.485585	261	-0.01472	0.123309	261	-1.0464	0.491326	261	95.23	226.15
1165-474	242	1.02723	0.449204	242	-0.00722	0.14276	242	-1.0145	0.455478	242	59.4	194.47
1166-278	77	0.96067	0.327193	77	0.06662	0.205004	77	-0.9206	0.36999	77	178.12	318.34
1167-271	63	0.92713	0.252979	63	0.05404	0.133759	63	-0.9136	0.261417	63	164.48	364.86

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
1168-322	182	0.62846	0.297675	182	0.01165	0.100193	182	-0.6144	0.309762	182	-141.63	237.73
1169-103	70	1.10087	0.316399	70	-0.00372	0.12488	70	-1.0935	0.317546	70	246.89	434.63
1170-169	114	1.15282	0.414664	114	0.0058	0.147996	114	-1.1421	0.418134	114	227.4	381.18
1171-266	127	1.00941	0.338681	127	0.03936	0.143816	127	-0.9957	0.346757	127	187.88	359.43
1172-503	106	1.15367	0.410146	106	0.00389	0.133482	106	-1.1447	0.413869	106	241.83	398.54
1173-138	24	0.53508	0.244396	24	-0.03468	0.074636	24	-0.5177	0.268268	24	-264.13	301.7
1174-938	99	0.98193	0.378828	99	0.04822	0.10989	99	-0.9728	0.383436	99	124.28	224.7
1175-974	102	1.23314	0.420516	102	0.03371	0.129974	102	-1.2245	0.424508	102	207.06	292.95
1176-229	115	1.10248	0.364162	115	0.02478	0.120953	115	-1.0944	0.367929	115	237.62	366.88
1177-088	132	1.13927	0.435442	132	0.02213	0.150383	132	-1.1273	0.440392	132	160.38	281.63
1178-825	96	1.09984	0.43208	96	0.04741	0.151665	96	-1.0884	0.432056	96	153.04	271.39
1179-845	102	1.27316	0.276449	102	-0.0004	0.156198	102	-1.262	0.283912	102	223.46	420.13
1180-118	234	0.5554	0.282875	234	-0.01288	0.096639	234	-0.5411	0.293726	234	-78.3	169.39
1181-830	241	0.63842	0.301363	241	-0.00728	0.104434	241	-0.6251	0.310975	241	-79.87	165.39
1182-998	221	0.5887	0.283041	221	0.00261	0.105735	221	-0.5722	0.296895	221	-83	195.92
1183-647	3	0.31913	0.116013	3	-0.12423	0.034501	3	-0.2931	0.114114	3	0	0
1184-980	30	0.83201	0.060649	30	-0.07964	0.109623	30	-0.8211	0.06158	30	79	96.37
1185-168	149	1.17704	0.535129	149	-0.05734	0.140388	149	-1.1636	0.543089	149	103.95	245.6
1186-942	160	1.22939	0.421064	160	-0.03356	0.167778	160	-1.2163	0.424641	160	195.32	314.34
1187-479	81	0.92108	0.195918	81	0.03364	0.205891	81	-0.8954	0.205317	81	111.63	229.09
1188-655	98	1.09345	0.334992	98	0.04197	0.166845	98	-1.0786	0.339255	98	188.43	320.3
1189-340	101	0.88885	0.140072	101	0.06815	0.152783	101	-0.8724	0.144102	101	140.59	271.25
1190-249	257	1.07489	0.466896	257	-0.02374	0.128799	257	-1.0642	0.473019	257	84.31	217.89
1191-375	129	1.24736	0.42965	129	-0.00737	0.161342	129	-1.2343	0.437192	129	220.57	303.13
1192-482	106	1.09776	0.313859	106	0.01403	0.171559	106	-1.083	0.31849	106	186	293.86
1193-904	91	0.72833	0.26804	91	-0.05293	0.081447	91	-0.7201	0.272831	91	-276.03	267.1
1194-429	105	1.0665	0.347305	105	0.00723	0.113467	105	-1.06	0.348647	105	254.99	342.07
1195-230	214	1.2708	0.486078	214	-0.01898	0.129825	214	-1.2625	0.490109	214	-66.02	98.64

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
1196-325	273	1.35501	0.515896	273	-0.04045	0.107139	273	-1.3502	0.515961	273	84.75	221.33
1197-666	323	0.59454	0.355428	323	0.05132	0.144578	323	-0.5232	0.427555	323	-9.28	76.83
1198-040	43	1.36567	0.520321	43	-0.05766	0.150962	43	-1.3541	0.526144	43	0	0
1199-594	274	1.0066	0.43862	274	-0.02438	0.137952	274	-0.9945	0.443989	274	-1.83	249.6
1200-656	94	0.65517	0.251683	94	-0.09611	0.158352	94	-0.6302	0.247614	94	-4.72	199.22
1201-642	439	0.68962	0.304097	439	0.07267	0.113535	439	-0.6742	0.308813	439	-65.37	212.37
1202-851	414	0.56299	0.301807	414	0.04983	0.121573	414	-0.5454	0.305498	414	48.79	188.87
1203-623	196	0.6408	0.236927	196	-0.00019	0.122611	196	-0.6274	0.241111	196	-4.57	174.62
1204-843	271	1.19969	0.4774	271	0.01678	0.144124	271	-1.191	0.477253	271	-21.2	152.24
1205-831	296	1.17737	0.445927	296	0.02329	0.145947	296	-1.1676	0.447097	296	-33.69	157.65
1206-877	97	0.44988	0.150882	97	-0.034	0.145041	97	-0.4222	0.157985	97	-6.68	114.88
1207-256	307	1.02463	0.455946	307	-0.03009	0.116677	307	-1.0156	0.460382	307	19.35	250.29
1208-076	187	0.945	0.165568	187	0.06263	0.135217	187	-0.9338	0.162334	187	-48.56	190.54
1209-543	183	0.65767	0.347394	183	0.05319	0.147136	183	-0.6349	0.354665	183	7.2	211.81
1210-862	177	0.70649	0.337225	177	0.01049	0.116587	177	-0.6961	0.3387	177	-12.11	188.69
1211-988	267	0.85461	0.30695	267	0.0821	0.112707	267	-0.8418	0.310869	267	-88.59	226.07
1212-254	97	0.71848	0.278314	97	0.02749	0.115642	97	-0.7079	0.280266	97	61.28	220.64
1213-264	152	0.44173	0.180056	152	0.06035	0.108902	152	-0.3928	0.240875	152	70.52	186.41
1214-756	219	0.97013	0.44648	219	-0.00768	0.136042	219	-0.958	0.451858	219	24.66	232.49
1215-304	197	1.17535	0.558955	197	-0.0106	0.306407	197	-1.0675	0.67946	197	117.74	277.18
1216-667	104	0.69701	0.28254	104	0.04498	0.138017	104	-0.6793	0.288618	104	126.21	314.58
1217-452	315	1.18431	0.482033	315	-0.02493	0.147458	315	-1.1734	0.485688	315	-22.06	219.48
1218-396	347	1.06251	0.487277	347	-0.05598	0.134634	347	-1.0481	0.49669	347	85.05	211.07
1219-677	201	1.00885	0.485293	201	-0.02979	0.132882	201	-0.9946	0.495667	201	-2.24	300.78
1220-005	374	0.55038	0.23463	374	0.01474	0.104242	374	-0.5384	0.238861	374	-26.94	78.29
1221-363	249	1.03405	0.509693	249	-0.04084	0.166068	249	-1.0177	0.514032	249	77.64	196.75
1222-027	278	1.1611	0.535929	278	-0.04424	0.156615	278	-1.1488	0.537745	278	76.74	162.8
1223-762	265	1.21723	0.542241	265	-0.03928	0.141196	265	-1.2072	0.544999	265	78.96	150.87

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
1224-533	311	1.07825	0.465463	311	-0.01523	0.15979	311	-1.0642	0.470129	311	63.11	183.16
1225-691	193	1.01769	0.136094	193	0.06513	0.109261	193	-1.0096	0.137114	193	-51.32	187.64
1226-354	277	0.47507	0.245666	277	0.02155	0.121079	277	-0.4548	0.253246	277	8.42	63.37
1227-424	334	0.74782	0.356518	334	-0.10574	0.231308	334	-0.6948	0.373001	334	89.89	213.94
1228-453	317	0.70502	0.342283	317	0.01522	0.145706	317	-0.6735	0.373198	317	-3.44	41.04
1229-649	159	1.31488	0.37183	159	-0.09501	0.131413	159	-1.3019	0.382311	159	109.32	264.82
1230-420	277	0.66597	0.366972	277	0.05772	0.150708	277	-0.6102	0.424257	277	-14.04	130.83
1231-471	283	1.05632	0.43221	283	-0.00462	0.146536	283	-1.0432	0.439315	283	88.45	212.23
1232-748	206	0.6599	0.295017	206	0.06105	0.163965	206	-0.6341	0.299839	206	-51.2	229.05
1233-572	229	1.00906	0.409313	229	0.01207	0.111179	229	-0.9991	0.418592	229	3.6	203.33
1234-386	465	0.55976	0.27915	465	0.05611	0.131657	465	-0.539	0.283306	465	51.63	181.22
1235-234	141	1.14899	0.500787	141	-0.07746	0.151213	141	-1.1326	0.509527	141	96.39	228.03
1236-171	123	0.40414	0.17896	123	0.06934	0.127083	123	-0.3268	0.260816	123	79.18	188.01
1237-825	235	0.61253	0.30447	235	0.01102	0.112369	235	-0.5925	0.322729	235	-72.86	199.55
1238-899	122	1.06043	0.412467	122	0.0352	0.155006	122	-1.0466	0.417375	122	110.04	224.69
1239-080	120	0.52184	0.244917	120	-0.09683	0.107255	120	-0.4916	0.264492	120	-134.53	220.39
1240-728	334	0.62401	0.284722	334	0.03807	0.127504	334	-0.6064	0.291613	334	-7.29	50.84
1241-881	265	1.21924	0.533363	265	-0.0626	0.127509	265	-1.2088	0.538222	265	52.22	147.42
1242-006	329	0.61784	0.292064	329	0.01743	0.121763	329	-0.6017	0.299796	329	-7.55	71.57
1243-779	391	0.57289	0.265198	391	0.04156	0.123887	391	-0.5533	0.274461	391	-7.58	180.42
1244-777	159	1.46708	0.514197	159	-0.03172	0.153176	159	-1.4574	0.518083	159	41.94	121.65
1245-409	168	0.92399	0.421176	168	-0.02905	0.133374	168	-0.908	0.433773	168	41.94	252.21
1246-071	108	0.86873	0.251198	108	0.03062	0.144436	108	-0.8559	0.252391	108	89.83	201.2
1247-124	107	1.35751	0.469924	107	0.03155	0.1153	107	-1.3505	0.475118	107	188.04	251.26
1248-445	156	0.94121	0.28153	156	0.04511	0.146341	156	-0.9268	0.287981	156	63.63	207.48
1249-504	307	1.19046	0.456121	307	-0.00584	0.137446	307	-1.1814	0.459043	307	-22.35	194.66
1250-020	264	0.59832	0.275575	264	0.01574	0.13943	264	-0.5755	0.288291	264	30.85	188.12
1251-625	212	0.62959	0.314988	212	-0.00018	0.096572	212	-0.6109	0.336451	212	-95.42	205

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
1252-605	198	0.61406	0.30308	198	-0.0096	0.100205	198	-0.5992	0.315995	198	-78.06	185.56
1253-448	160	1.40853	0.471883	160	0.02481	0.153882	160	-1.3993	0.473836	160	150.81	260.52
1254-486	222	1.08634	0.546799	222	-0.02519	0.264109	222	-0.9777	0.67374	222	89.76	229.19
1255-370	104	1.03164	0.386093	104	0.01681	0.157825	104	-1.0174	0.391666	104	217.23	346.18
1256-009	80	0.59727	0.315631	80	-0.07481	0.07426	80	-0.574	0.340614	80	-83.28	181.3
1257-492	281	1.10279	0.510396	281	-0.02215	0.157645	281	-1.0896	0.513886	281	83.14	205.19
1258-940	360	0.65008	0.314912	360	0.04109	0.140057	360	-0.6327	0.316596	360	56.64	169.87
1259-558	126	0.3912	0.172081	126	0.05041	0.091191	126	-0.3723	0.182376	126	60.4	162.34
1260-425	284	1.11396	0.440385	284	-0.00513	0.15553	284	-1.1004	0.447074	284	83.64	207.46
1261-637	257	0.64538	0.281848	257	0.06246	0.112112	257	-0.6295	0.288656	257	42.6	162.86
1262-315	154	0.91936	0.404643	154	-0.03971	0.144065	154	-0.9032	0.413453	154	-99.21	204.14
1263-092	295	0.65041	0.280446	295	0.06396	0.118093	295	-0.6337	0.286665	295	63.26	199.69
1264-966	153	0.85954	0.417709	153	-0.02475	0.123682	153	-0.8489	0.420563	153	-64.67	127.31
1265-236	291	0.61929	0.250965	291	0.07057	0.126126	291	-0.5971	0.263063	291	36.76	137.53
1266-220	116	0.94848	0.459653	116	-0.01458	0.1372	116	-0.9343	0.468083	116	-158.59	214.87
1267-678	185	0.77667	0.396321	185	-0.02738	0.145698	185	-0.7584	0.404143	185	19.59	219.26
1268-101	320	1.2505	0.514075	320	-0.04524	0.147062	320	-1.2388	0.519359	320	58.39	177.13
1269-650	350	0.65702	0.320902	350	0.00069	0.134067	350	-0.6167	0.369407	350	-40.27	203.47
1270-783	166	1.13434	0.203329	166	0.05572	0.163161	166	-1.1167	0.227092	166	-4.52	34.74
1271-163	330	0.98855	0.421996	330	-0.053	0.122829	330	-0.9778	0.425882	330	75.25	185
1272-161	153	1.20436	0.446506	153	-0.05807	0.159841	153	-1.1895	0.454173	153	67.64	195.49
1273-262	309	1.12563	0.500349	309	-0.04664	0.123142	309	-1.1158	0.505148	309	81.87	217.34
1274-662	130	0.40866	0.176306	130	0.08728	0.078359	130	-0.388	0.183952	130	53.18	162.26
1275-916	51	0.71104	0.266456	51	0.01566	0.082399	51	-0.7056	0.26806	51	0	0
1276-105	335	0.97953	0.466711	335	-0.08908	0.118644	335	-0.9472	0.508275	335	63.37	174.7
1277-454	181	0.85945	0.28034	181	0.02129	0.132434	181	-0.8412	0.303124	181	41.04	244.83
1278-716	142	1.29819	0.375383	142	-0.08816	0.111854	142	-1.2875	0.385175	142	57.53	152.41
1279-369	312	1.16173	0.457166	312	-0.00758	0.145194	312	-1.1496	0.464813	312	-30.35	99.95

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
1280-757	327	1.10078	0.432281	327	-0.01002	0.169516	327	-1.0873	0.433235	327	-7.81	286.87
1281-768	160	1.05688	0.313695	160	-0.08672	0.13951	160	-1.0415	0.322122	160	0.88	19.03
1282-024	269	1.078	0.5047	269	-0.08712	0.285986	269	-1.0394	0.497285	269	78.63	199.01
1283-551	109	0.52067	0.217569	109	0.04948	0.107718	109	-0.5062	0.219755	109	95.39	214.26
1284-242	134	0.45578	0.175833	134	0.03463	0.137504	134	-0.4327	0.177447	134	115.26	238.01
1285-524	299	0.67683	0.340796	299	0.05785	0.12547	299	-0.6606	0.344713	299	3.92	43.28
1286-511	153	1.16717	0.465167	153	-0.04824	0.126252	153	-1.1564	0.472407	153	59.26	171.55
1287-938	118	0.41153	0.177081	118	0.04692	0.119484	118	-0.39	0.179609	118	41.66	105.66
1288-633	415	0.68845	0.272436	415	0.03101	0.134277	415	-0.672	0.278602	415	-78.25	201.87
1289-005	246	1.05052	0.412348	246	-0.08151	0.114523	246	-1.0397	0.4158	246	69.03	200.14
1290-046	115	0.43281	0.160623	115	0.06111	0.108765	115	-0.4143	0.161197	115	56.27	148
1291-541	322	1.16348	0.488184	322	-0.04381	0.140401	322	-1.1505	0.496907	322	59.86	198.5
1292-913	168	1.16056	0.455876	168	-0.06797	0.148894	168	-1.1429	0.47102	168	99.27	242.4
1293-243	119	0.44544	0.197753	119	0.03661	0.129728	119	-0.3473	0.315251	119	22.1	97.1
1294-035	89	0.70935	0.197447	89	-0.07903	0.124775	89	-0.6934	0.199231	89	-22.43	150.27
1295-027	346	0.93215	0.421063	346	-0.09651	0.133368	346	-0.9153	0.425941	346	73.42	182.77
1296-143	133	1.32889	0.284839	133	-0.07058	0.113827	133	-1.3213	0.288934	133	50.9	227.91
1297-232	99	0.4993	0.33963	99	-0.0136	0.155411	99	-0.404	0.421874	99	-100.08	175.95
1298-044	103	0.64754	0.178908	103	-0.06385	0.118268	103	-0.6321	0.184139	103	-25.25	175.88
1299-346	240	0.95308	0.353809	240	0.00208	0.137226	240	-0.9417	0.357743	240	-6.04	150.67
1300-062	225	1.03363	0.470561	225	-0.01739	0.138465	225	-1.0198	0.48001	225	43.84	212.41
1301-464	131	1.45815	0.284302	131	-0.09343	0.111032	131	-1.4512	0.283235	131	-14.47	88.68
1302-475	290	1.20459	0.429818	290	0.01516	0.128869	290	-1.1967	0.432263	290	-38.44	159.92
1303-515	257	1.18243	0.56152	257	-0.0332	0.151739	257	-1.1701	0.566021	257	67.01	169.48
1304-100	340	0.97848	0.448597	340	-0.06965	0.120221	340	-0.9625	0.461638	340	94.69	199
1305-723	249	0.63291	0.306001	249	0.08111	0.114573	249	-0.6121	0.316122	249	-69.16	176.34
1306-905	44	0.49853	0.352346	44	0.047	0.071767	44	-0.4892	0.355233	44	-53.64	114.19
1307-367	206	0.9853	0.156064	206	0.08114	0.143177	206	-0.9714	0.156635	206	-94.09	218.27

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
1308-469	133	0.71222	0.304407	133	0.03584	0.101618	133	-0.7012	0.311097	133	90.47	234.93
1309-441	329	1.01553	0.469038	329	-0.02275	0.160964	329	-0.9984	0.47765	329	61.96	150.15
1310-818	317	1.12826	0.47324	317	-0.00439	0.129039	317	-1.1192	0.477127	317	-61.8	179.39
1311-155	257	1.11781	0.572702	257	-0.02781	0.141889	257	-1.105	0.579291	257	57.94	175.97
1312-017	286	1.00018	0.43567	286	-0.02346	0.132839	286	-0.9893	0.43971	286	33.61	143.75
1313-705	233	1.27075	0.502805	233	-0.03966	0.131576	233	-1.2624	0.505122	233	64.08	182.63
1314-548	79	0.71393	0.312388	79	-0.06334	0.082222	79	-0.6781	0.370461	79	-114.34	202.95
1315-414	120	1.14526	0.388889	120	-0.00736	0.134708	120	-1.1352	0.395293	120	42.45	128.36
1316-195	413	0.56663	0.282827	413	0.04855	0.125879	413	-0.5486	0.286341	413	57.67	198.88
1317-887	353	0.99763	0.432634	353	-0.07537	0.121672	353	-0.9858	0.436119	353	83.5	208.33
1318-512	259	1.17674	0.554262	259	-0.03246	0.126383	259	-1.1675	0.558541	259	109.04	265.89
1319-807	270	1.03302	0.512791	270	-0.04111	0.141696	270	-1.0206	0.516496	270	58.92	184.61
1320-891	238	1.15938	0.53298	238	-0.04452	0.131373	238	-1.1477	0.540235	238	76.53	200.37
1321-030	6	0.7751	0.437681	6	0.1343	0.128097	6	-0.7592	0.427582	6	0	0
1322-910	308	1.14906	0.451968	308	0.0157	0.138589	308	-1.1395	0.454635	308	-26.09	197.98
1323-039	191	0.87295	0.341988	191	-0.07835	0.12311	191	-0.8585	0.347626	191	-17.53	144.23
1324-250	363	0.60029	0.280147	363	0.01639	0.13497	363	-0.5834	0.282834	363	-20.78	96.54
1325-132	119	0.40539	0.157861	119	0.03015	0.113322	119	-0.3864	0.162193	119	118.34	222.42
1326-953	210	0.72133	0.378341	210	-0.02041	0.090283	210	-0.7126	0.383608	210	11.66	79.79
1327-738	501	0.65094	0.246079	501	0.0586	0.134397	501	-0.6283	0.260854	501	-31.99	74.05
1328-325	501	0.549	0.261023	501	0.06897	0.146746	501	-0.5095	0.289441	501	2.23	60.16
1329-251	99	0.87072	0.226683	99	0.05253	0.109255	99	-0.8609	0.232162	99	83.01	165.15
1330-545	189	0.64346	0.27817	189	0.14379	0.128853	189	-0.5932	0.320123	189	115.75	292.42
1331-679	150	1.14936	0.469182	150	-0.06775	0.124237	150	-1.1394	0.472143	150	44.29	109.45
1332-814	103	0.35814	0.123598	103	0.08286	0.120042	103	-0.3236	0.13309	103	-42.54	154.1
1333-613	189	0.52771	0.284432	189	-0.03225	0.152461	189	-0.4868	0.313619	189	7.79	147.42
1334-350	91	0.45996	0.118516	91	0.16706	0.095962	91	-0.4151	0.127818	91	48.14	80.85
1335-655	30	0.53521	0.217068	30	0.11867	0.112347	30	-0.4947	0.251071	30	-48.47	65.46

CID	Horizontal Error (nm)			Cross Track Error (nm)			Along Track Error (nm)			Altitude Error (feet)		
	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev	Sample Size	Mean	Std Dev
1336-097	124	0.87516	0.413473	124	-0.03542	0.211789	124	-0.8188	0.470154	124	18.25	110.87
1337-958	501	0.66637	0.278251	501	0.0803	0.116506	501	-0.6416	0.299779	501	-2.49	32.17
1338-083	220	1.2305	0.470028	220	-0.01416	0.135217	220	-1.2207	0.47588	220	0	0
1339-772	211	1.02488	0.429514	211	-0.08605	0.124583	211	-1.011	0.435706	211	2.52	19.88
1340-797	196	1.03636	0.440599	196	-0.08542	0.125163	196	-1.0234	0.444849	196	0	0
1341-708	272	0.74597	0.400088	272	-0.0189	0.12176	272	-0.7014	0.457835	272	20.24	107.47
1342-112	389	0.68504	0.261484	389	-0.08797	0.126331	389	-0.6542	0.293318	389	-6.26	97.62

8.3 Paired Versus Unpaired Experiments

In both the Two-Sample and Paired test, the null hypothesis was essentially the same, namely that the differences between the two runs under study are zero. This is illustrated in Equation 2. In the Two-Sample test, the individual sample means are estimated and difference calculated, while in the Paired test, the individual differences are calculated and the mean of these differences is estimated.

$$H_o : \mu_1 - \mu_2 = \mu_D = 0$$

Equation 2

where μ_1 is the population mean of the treatment run one, μ_2 is the population mean of the treatment run two, and μ_D is the mean of the differences

However, the test statistic and resulting sample size are very different. The test statistic for the Two-Sample test is presented in Equation 3. As shown, the denominator is a function of the individual treatments sample variances and their respective sample sizes.

$$\text{Test statistic} : t = \frac{\bar{x} - \bar{y}}{\sqrt{\frac{s_1^2}{m} + \frac{s_2^2}{n}}} \quad \text{Equation 3}$$

where \bar{x} is the sample mean of the first treatment run and \bar{y} is the sample mean of the second treatment run, s_1^2 is the sample variance of the first treatment run and m is the sample size of this run, and s_2^2 and n are the same for the second run.

The rejection region of the Two-Sample t test is expressed in the following Equation 4.

$$\text{Reject null hypothesis if } t \geq t_{\alpha/2,v} \text{ or } t \leq -t_{\alpha/2,v} \quad \text{Equation 4}$$

where $t_{\alpha/2,v}$ or $-t_{\alpha/2,v}$ are parameters taken from the student-t distribution, α is the significance level of the test, and v is the degrees of freedom for this test⁴.

For the Paired t test, the test statistic is illustrated in Equation 5.

$$t = \frac{\bar{d}}{s_D / \sqrt{n}} \quad \text{Equation 5}$$

where the s_D is the sample standard deviation of the differences (i.e. the $D_i = x_i - y_i$ with i as the index for each flight), \bar{d} is the average of the differences, and the n is the sample size of these differences.

The rejection region of the Paired t test is expressed in the following Equation 6.

⁴ This degrees of freedom parameter is a function of the number of samples taken for the test and approximately equal to $m+n-2$. The actual formula is defined in Section 9.2 of (Devore, 2000).

Reject null hypothesis if $t \geq t_{\alpha/2,n-1}$ or $t \leq -t_{\alpha/2,n-1}$

Equation 6

Comparing these two test statistics defined in Equation 3 and Equation 5, the denominator is where they are different. For the Two-Sample test, the denominator is the sum of the individual run standard deviations and their sample sizes, while for the Paired test the denominator is the standard deviation of the individual differences within the runs. The relationship of these variances (square of the standard deviation) is illustrated in Equation 7 taken from (Devore, 2000) and (Montgomery, 1997).

$$V(\bar{X} - \bar{Y}) = V(\bar{D}) = V\left(\frac{1}{v} \sum D_i\right) = \frac{V(D_i)}{v} = \frac{\sigma_1^2 + \sigma_2^2 - 2\rho\sigma_1\sigma_2}{v} \quad \text{Equation 7}$$

where $V(\bar{X} - \bar{Y})$ is the variance of the difference of the average for each treatment \bar{X} and \bar{Y} respectively, $V(\bar{D})$ is the variance of the average difference \bar{D} , v is the sample size of the treatments, σ_i^2 is the variance of the sample where i is the index of each sample, and ρ is the correlation coefficient for the two treatments

From Equation 7, the differences are equal, $\bar{D} = \bar{X} - \bar{Y}$. This variance is represented in the denominator of both statistical tests. However, the correlation coefficient, ρ , is assumed zero in the Two-Sample test, representing independence of the treatment runs. However, for the Paired test it is assumed at or close to one, representing a positive dependence between treatment runs. The other difference is the v sample size. For the Two-Sample test, the v is approximately equal to $m+n-2$ (m and n are the sample sizes per treatment run, 1 and 2, respectively). The Paired test's v is equal to $k-1$, where k is the number of differences. The number of differences k is equal to the smaller m or n if they are not equal, but k is the same as m or n if they are equal.

For the study presented in this document, the ρ was significantly positive as presented in Section 4. From Equation 7, the larger the correlation the smaller the variance and thus the Paired test achieves an improvement in accuracy over the Two-Sample test. Also, for the reasons presented in Section 4 and Section 5.2, the sample size for the Two-Sample test was large and in some cases too large for the precision of the data set.

In addition, Section 4.2 reports that the pairing of the sample means per flight and their associated differences normalizes the data set. To make this claim, Goodness-of-Fit tests and Normal Probability Plots were performed on each of the inferential tests (i.e. turning and vertical transitioning tests in Sections 4.2.1 and 4.2.2, respectively). As an example of the analysis that took place, the following Figure 42 illustrates the Normal Probability Plot of the along track error differences for the turning analysis. A data set that is normally distributed follows the diagonal red line in the diagram and is within the confidence interval bounds. This is the case for this data set and more of the same for all the other paired sample mean differences in this study. Furthermore, the Figure 42 presents a histogram of the along track error differences overlaid with the estimated normal distribution curve. Also, the Shapiro-Wilk Goodness-of-Fit test was applied supporting the same conclusions (SAS Institute Inc., 2003). Normalization of the data sets is critical feature of pairing because these statistical tests require the data to be approximately normally distributed.

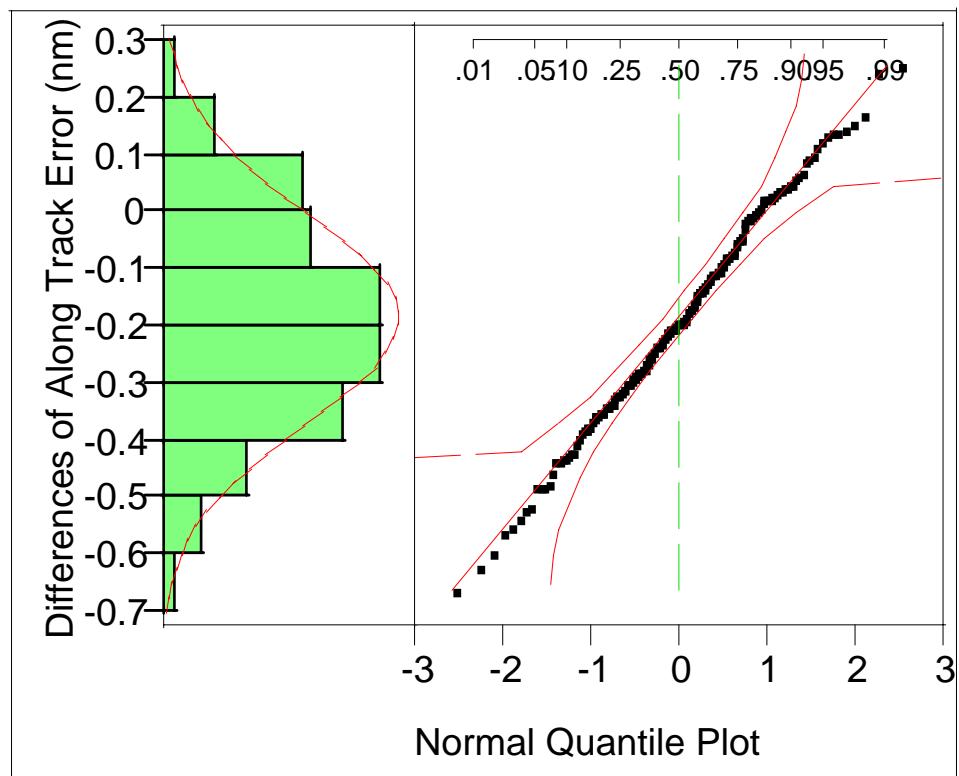


Figure 42: Turning Inferential Test - Normal Probability Plot for Differences

In summary, the Paired test has improved precision due to the significant positive correlation between treatment levels within a flight, reduces sample size that is beneficial for this study, and normalizes the data sets. *For all these reasons, the Paired test is highly recommended as the statistical test method for application in this study and future studies in the same context for ERAM.*